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Non-Observed Economy and Income Inequality: Is There a Causality Nexus?

by

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Vita

Suzana Gonçalves Coutinho Moreira was born in Monthey, Switzerland in the 31st of July, 1990. At the age of eleven she moved to Portugal and has attended the school in this country since then. Her interest for Economics began in the secondary school when she chose the course in social economics, which allowed her to enrol at the University of Porto in Economics. In September 2010 she joined AIESEC and, after one semester, she was promoted as a coordinator of a team, composed by 5 elements, in the department of Exchange Projects. She has maintained this position for one year. In 2012 she was enrolled one semester in France, Université Pierre Mendes - Grenoble, under the Erasmus Programme. She holds a bachelor degree in Economics from the University of Porto since 2012. Since 2013 she has been attending the Master in Economics at the same university. In the summer of 2014, she started working at Nutre Group as a Financial Analyst, her present job. This dissertation is the final contribution to obtain her Master Degree.

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When this academic year started I knew that it would be the most challenging year I have ever faced. In fact, expectations were correct, and this was an unbelievable year. Despite all the difficulties I faced – and I will not name them, or else this text will depress the reader – I'm proud to say that I learn unforgettable life lessons and that I grew up as to be a better person and a better professional, I hope.

I would like to first thank my parents, who have never doubt my capacities and for making me believe that I could succeed: thank you for our calm talks and support – I owe you every accomplishment; second, I'm thankful to my friends, the older ones, the university ones and the ones at my workplace, for being there for me, despite my absence; and third, I want to thank my supervisors who lead me by example and I can say, at this stage, that they play role models for me.

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Abstract

Nowadays governments show a growing interest on identifying the portion of the economic activity that is not observable or non-declared, either due to explicit tax evasion, to the illegal nature of the activities or just because production is devoted to auto consumption. Among other macroeconomic links, some literature refers that non-observed economy and inequality tend to walk along the same path. In fact, countries that present high estimated levels of the non-observed sector (in terms of GDP percentage) exhibit, simultaneously, high inequality values; conversely, lower estimations for the non-observed sector characterize developed countries and these exhibit lower income inequalities. This link has already been studied in the literature. However, there is still no systematic review on the theoretical channels relating the size of the non-observed sector and inequality; moreover, there seems to be no consensus on the causality relation between the two dimensions.

This dissertation provides an exhaustive review on the main mechanisms relating, potentially with reverse causality, inequality and the size and nature of non-observed economy, supported by both theoretical and empirical pieces of literature. Additionally, we provide an assessment of the causality relationship between non-observed economy and income inequalities and categorize the results by developed and developing countries. Using Granger Causality tests, we found strong statistical support for the hypothesis of income inequalities causing non-observed economy, and only finding the reverse causal nexus statistically relevant in developed countries. Moreover, we also provide more detailed evidence by estimating the relationship between these two variables using Two-Stage Least Squares methodology. This method allowed us to conclude that co-movement is positive when income inequality determines non-observed economy, whereas the relation is inverse (negative) when non-observed economy explains income inequality.

JEL Classification: E25, E26, I32, J3, O17

Keywords: Non-Observed Economy, Income Distribution, Underground Economy, Income Inequality

Resumo

Atualmente, assistimos a um crescente interesse por parte dos governos em identificar a parcela da atividade económica que não é observável ou não-declarada, que advém da evasão fiscal explícita, da natureza ilegal das atividades ou apenas da produção dedicada ao auto consumo. Entre outros impactos macroeconómicos, alguma literatura refere que a economia não observada e a desigualdade dos rendimentos tendem a caminhar no mesmo sentido. De facto, os países que apresentam elevados valores estimados para a atividade não-observada (em percentagem do PIB) exibem, simultaneamente, valores elevados de desigualdade; da mesma forma, as estimativas mais baixas do setor não-observado correspondem também a países que apresentam menor desigualdade na distribuição de rendimentos. Esta é uma relação que tem sido estudada na literatura. No entanto, ainda não existe uma revisão sistemática sobre os canais teóricos que explicam claramente os impactos recíprocos entre a economia não-observada e a desigualdade; além disso, parece não haver consenso sobre a relação de causalidade entre as duas dimensões.

Esta dissertação apresenta uma revisão exaustiva sobre os principais mecanismos relacionados, potencialmente, com a causalidade entre a desigualdade e a dimensão da economia não observada, apoiada por partes teóricas e empíricas da literatura. Além disso, oferecemos uma avaliação da relação de causalidade entre a economia não-observada e desigualdade, categorizando os resultados por países desenvolvidos e em desenvolvimento. Usando testes de Causalidade de Granger, encontramos apoio estatístico para a hipótese das desigualdades de rendimento causarem a economia não observada, apenas encontrando o nexo de causalidade inversa, estatisticamente relevante, para os países desenvolvidos. Oferecemos também evidência mais detalhada, através da metodologia *Two-Stage Least Squares*. Este método permitiu-nos concluir pelo co-movimento quando a desigualdade determina a economia não observada, enquanto a relação é inversa quando a economia não observada explica a desigualdade dos rendimentos.

Classificação JEL: E25, E26, I32, J3, O17

Palavras-Chave: Economia Não Observada, Distribuição dos Rendimentos, Economia Paralela, Desigualdade dos Rendimentos

Table of contents

List of Tables

List of Figures

Abbreviations

2SLS – Two-Stage Least Squares

GDP – Gross Domestic Product

GINI – Gini Coefficient

Ineq – Inequality

NOE – Non-Observed Economy

OECD – Organisation for Economic Co-operation and Development

1. Introduction

Nowadays governments are showing interest on identifying the portion of the economic activity that is not observable or non-declared, either due to explicit tax evasion, to the illegal nature of the activities or just because production is devoted to auto consumption. Causes and macroeconomic consequences of the presence of a non-observed sector are now widely explored in the literature. For example, a larger non-observed economy represents larger potential losses in terms of fiscal revenues that affect negatively welfare by reducing resources devoted to provide widespread education and health, social assistance and quality institutions. The latest estimations for the size of the shadow economy around the world (see, *e.g.*, Buehn and Schneider, 2012a) indicate that, in 2007, the non-observed sector represented 19.4% of GDP for the world economy, as well as 28.3% and 14.6% for the developing and OECD countries, respectively.

Among other macroeconomic links, some literature refers that non-observed economy and inequality tend to walk along the same path. In fact, countries that present high estimated levels of the non-observed sector (in terms of GDP percentage) exhibit, simultaneously, high inequality values; conversely, lower estimations for the non-observed sector characterize developed countries and these exhibit lower income inequalities (*cfr.* Benjamin *et al.*, 2014). This gives primary evidence to support a link between the size of the non-observed sector and income inequality.

This link has already been studied in the literature. However, there is still no systematic review on the theoretical channels relating the size of the non-observed sector and inequality; moreover, there seems to be no consensus on the causality relation between the two dimensions. It has already been established that income inequalities can increase the size of the non-observed economic activity (Chong and Gradstein, 2007): being part of the formal sector has a cost, for example in terms of income taxes, and it is possible to find no benefits from belonging to the formal sector for the poor in a cost-benefit perspective. Additionally, it has also been shown that the effects of taxes on inequality are ambiguous. On the one hand, tax revenues increase the quality of institutions that help to reduce poverty and income inequalities while, on the other hand, for a given tax rate, the poor are, in fact, more prone to escape from

formality, *e.g.*, not to pay taxes and, therefore, become non-observed (Dessy and Pallage, 2003). Thus, it is not yet clear whether the effect of a tax hike on reducing inequality will directly reduce non-observed economy or if its effect on increasing the non-observed sector will overlap the latter and will worsen income inequality.

Thereby, our research questions are: (i) what are the main mechanisms relating inequality and the size of non-observed economy?; (ii) what is the dominant causality relation – from inequality to non-observed economy or the other way around?; and finally (iii) what is the sign of the relationship: are these variables co-moving or are they inversely related?

The aim of this dissertation is to give an overall review on this subject, supported by both theoretical and empirical strands of the literature. Additionally, we intend to provide an assessment of the causality relation between non-observed economy and income inequality, using a set of developed and developing countries, and further detail the nature and magnitude of the link between these two variables.

The first two sections are devoted to the literature review. Accordingly, in chapter 2, (i) we define the concepts of non-observed economy and inequality and (ii) identify the main macroeconomic impacts relating to both. In chapter 3 we present the mechanisms through which (i) the size of the non-observed economy affects income inequality and (ii) those operating in the reverse order. Moreover, we provide a review on the main results of the empirical literature testing these mechanisms. In chapter 4 we provide an empirical analysis using a baseline panel of annual data for developed and developing countries and covering the years 1995-2009. The panel is reduced for alternative applications. First, we intend to test the (reverse) Granger-causality between the size of non-observed economy and income inequality. Second, we intend to assess the impacts of the non-observed economy on inequality in a more detailed way, controlling for other determinants of inequality and non-observed economy, using the Two-Stage Least Squares methodology. Finally, chapter 5 encloses the main conclusions of the work.

2. Definitions and Macroeconomic Implications of Non-observed Economy and Inequality

2.1. Definitions of Inequality and Non-observed Economy

Inequality is a rather wide concept and its multiple dimensions appear to have diversified impacts on the economic activity. In fact, in the literature we find alternative definitions of inequality such as gender, education, access to employment, and wealth and income distribution inequality, which have diverse impacts on the economy. Though, most of literature extensively refers to income and wealth inequality, since it better encompasses all the dimensions of inequality across individuals (Neves and Silva, 2014). This is also the definition that we will adopt hereafter in this work. The Gini coefficient is the most commonly used measure to distinguish between economies where the income distribution is more equal (values close to 0) or more unequal (values close to 1).

For some authors, income inequality is often linked with the functioning of the labour market: major increases in inequality occur when the labour share of the income distribution falls, once wage inequality is smaller than that of non-labour incomes (Bertoli and Farina, 2007). Some other authors, relying on the Stopler-Samuelson theorem, argue that income inequality may also result from trade, revealing that an increase on trade increases income in high-skilled abundant countries while it decreases income in low-skilled abundant countries (*cfr.* Kurokawa, 2014). In this work we will explore how the dimension of non-observed sector affects inequality, in either through a unilateral or bilateral relation.

The designation of non-observed economy varies across the literature. In fact, we can find it labelled as underground, shadow, unofficial, parallel, irregular, black, subterranean, hidden, occult, informal and, finally, as non-observed economy. In order to be consistent it is important to assess the designation that prevails in the literature. OECD (2002) provides a terminology that allows us to categorize the different sets of non-observed activities. The terminology includes four different categories of activities in the definition of Non-observed Economy: (i) underground production – this considers activities that are productive and legal but are deliberately hidden from the authorities to

avoid taxes or restricting regulations; (ii) illegal production – activities that are productive but result in goods and services forbidden by law; (iii) informal sector – activities that are also productive but come from unregistered companies or households; and finally, (iv) self-consumption – production of households for own final use. Later, OECD (2014) added a fifth set of non-observed activities labelled as statistical underground, a residual category that includes data that missed from being accounted due to statistical errors or software deficiencies. Still, the definition remains relatively common: the non-reported economy refers to all activities that contribute to the overall production of a given country but is not reported to the governments (*cfr.* Rosser Jr. *et al.*, 2000). From hereafter, and for the sake of being fully encompassing, we will refer to all these activities as non-observed economy (*NOE*).

Because of not being officially registered, this causes difficulties on the identification of non-observed activities or of the economic agents involved, and thus on its quantification (Schneider and Enste, 2000). Schneider and Enste (2000) identify non-observed activities as monetary or non-monetary, legal or illegal and, within the former categorization, activities are further classified as resulting from tax avoidance or tax evasion (see Table 1). Such categorization makes more clear what should or should not be included under the label of non-observed activity. Schneider and Enste (2002) test the effect of enforcement on the size of the non-observed sector and find that more than the fiscal policy, government's enforcement is a far more important determinant of the non-observed sector. Other authors focus on the relationship between corruption and the size of non-observed sector (*e.g.*, Choi and Thum, 2005, and Dreher and Schneider, 2010).

Table 1. Schneider and Enste's classification of *Shadow Economy*.

	Monetary Transactions		Non-monetary Transactions	
Illegal Activities	Trade in stolen goods: drug dealings and manufacturing; prostitution, gambling; smuggling and fraud		Barter: drugs, stolen goods, smuggling etc. Produce or growing drugs for own use	
Legal Activities	Tax Evasion Unreported income from self-employment; wages,	Tax Avoidance Employee discounts, fringe benefits	Tax Evasion Barter of legal services and goods	Tax Avoidance All do-it yourself work and neighbour help

	salaries and assets from unreported work related to legal services and goods	

Source: *Cfr.* Schneider and Enste (2000).

The dimension of the non-observed sector can be assessed by: (i) direct approaches; (ii) indirect approaches; (iii) currency approach; and (iv) dynamic general equilibrium models. The direct approach consists on micro-economic or micro-econometric methods which gather data on households through surveys and interviews or through tax audit. Because they rely on voluntary answers to queries, it is often argued that these methods fail to consistently reveal all non-observed activities; moreover, the difficulties on collecting the necessary information also makes this method to be the least used and the most prone to devious estimations (*cfr.* Abdih and Medina, 2013). The indirect approach explores the macroeconomic links that can be assessed between the size of non-observed sector and the overall economy. Among others, there is a comparison of the differences between the national income and total expenditures, between the actual and the official labour force participation (any difference may arise from non-observed labour); between overall transactions and national income and, finally, some methods rely on the strong correlation between the growth of electricity consumption and the GDP growth rate (taking electricity consumption as one of the best indicators of overall economic activity, official and unofficial, estimations of unofficial economy rely on the analysis of deviations between the electricity consumption and the official GDP growth rates). Although indirect approaches are widely used in the literature, these methods present limitations such as automatically neglecting all the other activities that also gather important dimensions of the non-observed sector when strictly using one (Schneider, 2005). Third, the currency approach is based under the strong assumption that transactions amid non-observed activities are made in cash in order to escape to any form of recording. This approach estimates the volume of the non-observed transactions by assessing the differences between the increase in effective currency demand and currency demand econometrically estimated based on conventional factors (fundamentals). Estimations require data on variables such as development of income, payment habits, interest rates,

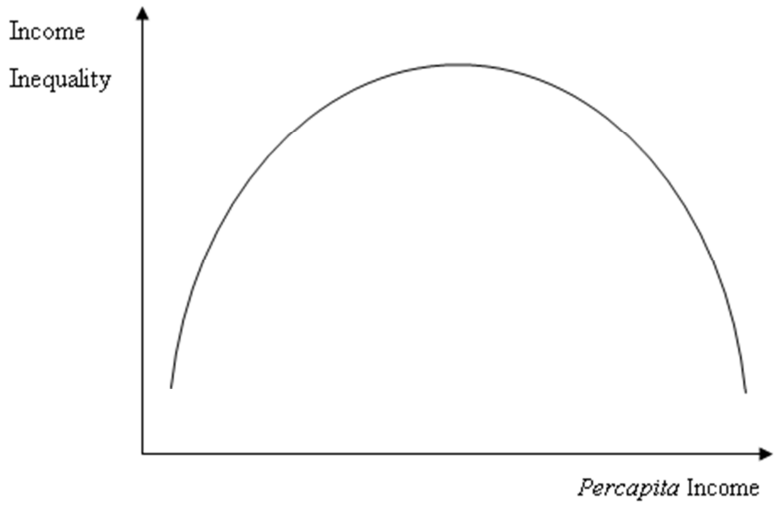
etc., (Schneider, 1986). Then, the discrepancies between both values are attributed to unconventional factors, like non-registered activities (Tanzi, 1980). However, this approach presents major difficulties in finding the right factors (and data) to reliably assess the "formal" currency demand. Fourth, dynamic general equilibrium models rely on microeconomic founded assumptions that avoid *ad-hoc* econometric specifications and assumptions that tend to lead to subsequent and cumulative estimation errors (Elgin and Oztunali, 2012). In particular, Elgin and Oztunali (2012) rely on a two sector model: formal and non-observed and they match observable variables from the data gathered and then back out the estimations for the unobservable variables. The authors drew a model and solved it in steady state. This step is important in order to assess the different parameters of their model based on observable and available data for the countries. Finally, after calibrating the parameters, they run their non-observed economy estimation retrieving the size on non-observed sector in terms of GDP. Their estimations cover 161 countries with data from 1950 up to 2009. The observable variables considered in their model regard items such as labour output and productivity, consumption, unemployment, informal technology and hours devoted from households to formal technologies of production.

2.2. Macroeconomic Implications

In this section we intend to give an overview of the main macroeconomic implications of inequality and non-observed economy. The aim is to compile, in brief, the main consequences of both on economic growth, as well as on other selected macroeconomic variables.

Income inequality has been approached through various dimensions in the literature. First, regarding the relationship with the evolution of income *per capita*, Kuznets (1955) firstly demonstrated that such relationship exhibited a hump-shaped form.

Figure 1. Kuznet's Curve



In fact, as the figure shows, according to the Kuznets hypothesis, income inequality tends to increase alongside with economic growth for lower income countries and, from a sufficiently high *per capita* income onwards, returns to lower levels of inequality as *per capita* income rises. Finding support for the Kuznets hypothesis, Alderson and Nielson (1997), focusing on the evolution of U.S economy between 70 and 90's, explained the U-Turn of inequality levels that U.S economic growth faced during that period. Furthermore, the authors were able to separate the phenomenon in two different strands of variables: (i) related to the impact of economic development and (ii) the ones that contributed to the upswing in income equality in the U.S economy. For the first category of variables, the authors controlled for urbanization and found that this has a positive impact on inequality; shifts from agriculture to others sectors reveal a non-relevant impact on income inequality; increases of population are, in the author's perspective a weak indicator for income inequality; heterogeneity of educational attainment revealed a strong impact on income inequality, which in turn revealed that education plays a major role in advanced economies and on income distribution; racial dualism in the U.S was also found to be relevant to the dynamics of income inequality. For the second strand of variables the authors mentioned female labour force to be strongly and negatively linked to the increase of income inequality, which supports the U-Turn hypothesis. This study allows understanding the complex dynamics between growth and income inequality. Indeed, this analysis suggests that the direction of the

impacts are not linear and may depend on the growth stage of a particular economy, hence highlighting a relevant factor to take into account when analysing income inequality: stage of growth or development of countries.

Goldberg and Pacvnik (2007), focusing on globalization effects on developing countries (which are the group of countries that present higher growth rates of income *per capita*) in the 80s and the 90s, show that the effects are positive on income inequality. The arguments presented in their analysis suggest that globalization increases income inequality mainly due to restricted labour market that prevents sectorial labour reallocation from agriculture to industrial activities, constraining the economic adjustments to operate within industrial activities instead of across all sectors of the economy.

Earlier, Klasen (2004) called this type of globalization pro-poor growth, while Basu (2006) enhanced the ambiguous effect of globalization on income inequality and the verdict should derive from the nature of the globalization. Moreover, Goldberg and Pacvnik (2007) conclude that the relationship between globalization and inequality is country, time and case specific.

Based on Neves and Silva (2014) survey on empirical facts about inequality and growth we identify four main implications of increases inequality amid countries. First, credit market imperfections imply that imperfections *per se* are the borrowing constraints that arise whenever one is applying for financing. In fact, the more unequal is income distribution, the larger the proportion of population constrained in the access to credit and financing. That leads us to the conclusion that unequal economies cannot have a financial system that can fulfil its primary function of resource distribution from who possess financial resources to those who demand credit for investment. In this view, the income inequality may, in fact, be an obstacle to economic growth.

Second, the fiscal policy also determines a negative link between inequality and economic growth. The link is established through the "political mechanism" (see, *e.g.*, Perotti, 1996) that revolves around the assumption that fiscal policy is decided according to the interests of the median voter. That implies that lower-wage individuals, who benefit from tax revenues, will rather support policies with higher tax rates, if the median voter theorem holds; this leads to an overall higher tax rate. Thus, more

inequality means, on the one hand, more government expenditures and higher tax rates. Higher tax rates, in turn, discourage investment, negatively affecting growth.

Third, the socio-political instability shows as well negative impacts of inequality on long-term growth. This channel is based upon two main links, the first being the relation that can arise from inequality and political instability. In fact, more unequal income distribution among individuals from the same country can lead to riots or strong deviations from the government policies (Keefer and Knack, 2002). The second link builds up on the relation between the political instability and economic growth in which it is set that instability discourages investment. Uncertainty is one of the main elements to take into consideration when deciding whether to concretize an investment and whenever governments fail to be respected by their peers that disfavours the perception of investment security. Hence, this link also enhances the attention that must be given to income inequality reduction to stimulate investment and consequently long term economic growth. Moreover, this channel remains the single one of the four on which there is consensus on its negative impacts.

Last and fourth, savings are the only factor that can identify benefits of inequality on economic growth. According to Kaldor (1956), richer individuals are more prone to save, thus inequality in this context promotes investment and growth through the savings of the wealthiest. Still, when adding the credit imperfections channel to the analysis, the results change over time. Indeed, Galor and Moav (2004) reach the conclusion that, in early phases characterized by scarce resources, the positive effect tends to be dominant. However, as economies develop and resources become abundant, this link becomes negative.

Although the main implications of inequality on economic growth have been identified, it is important to stress that empirical evidence have not yet reached a consensus, except for the third, on the effects of inequality on growth.

According to the adopted definition of non-observed sector, we can intuitively say that the proliferation of not registered (not quantified) economic activities may lead to important macroeconomic implications. In line with the precedent analysis, we will now enumerate some of the main macroeconomic consequences from a large or increasing non-observed sector. It is possible to find in the literature implications in the

following sectors or variables: (i) public provided services; (ii) monetary policy and inflation; (iii) fiscal policy; (iv) labour market; (v) corruption and (vi) economic growth.

Unregistered transactions imply, as we have previously said in the precedent section, potential fiscal losses and, as a consequence, any increase in the non-observed activity will increase those potential losses. Schneider (2005) mentioned that it is fair to assume that increases in non-observed sector generate losses in government revenues. Increases in the non-observed sector are, according to the author, significantly associated with rises in taxes and social contributions, generating a counterproductive effect and encouraging agents to opt for non-observed activities. Thereby, the countries decrease their budget revenues, thus leading to reductions on quality and quantity of public provided goods. The first implication will drive us to the conclusion that non-observed sector worsens overall welfare by reducing the ability of the states to carry on adequate provision of quality public goods and services that enhance growth and welfare (for a review, see Agénor and Yilmaz, 2013).

The second issue that seems to arise was pointed by Houston (1987) and claims that the larger the non-observed sector the stronger will be the effect on inflation through monetary policy (*cfr.* Schneider, 2005). This means that countries that present higher estimations of non-observed economy cannot be able to accurately control their monetary policy thus creating more than desired inflation. Inflation appears as a result of economies expanding and growing, however the countries have no interest in bearing high rates of inflation. As an example, not correctly anticipated inflation may contribute to the following issues: lower-than-expected purchasing power of the agents; increases in spending since the real interest rates may tend to be near zero – this will enlarge the magnitude of the impacts since spending generated inflation – and, finally, decrease in savings (Houston, 1987). Therefore, activities that remain non-observed will act in the economy at their own pace, and prevent the effectiveness of the monetary policy.

Adam and Ginsburgh (1985) find, through the use of a theoretical model that computes fiscal multipliers, that the non-observed sector is positively affected by expansionary fiscal policies. However, the impacts on multipliers depend on where the demand is directed to. If demand happens to be directed towards formal market, then the real impacts of fiscal policies underperform expected results by an estimated 12%. However, if demand directs towards non-observed markets, the underperformance can

reach 40%. Hence, these results mean that countries won't be able to effectively conduct fiscal policy if they are not fully aware of the size of their non-observed markets.

Additional research focusing on non-observed economy (*NOE*) and wages advocates that non-observed labour markets are more sensitive to macroeconomic impacts than over-regulated environments (Estevão and Filho, 2012). In particular, due to lower labour rigidities, wages become more flexible to macroeconomic conditions and thus allow for a quicker and less unemployment-painful economic adjustment. Hence, non-observed labour market reacts better to changes in unemployment rates, contrasting with the adjustment in observed-labour markets.

Corruption is also an issue extensively discussed in the literature when regarding the non-observed economy; however, no consensus has been reached so far. Choi and Thum (2005) enhance the important role that plays quality of institutions as an instrument that supports the official activities. Following their reasoning, the authors state that non-observed activities arise as distortions from the official ones, for example as an attempt to increase private gains. Furthermore when testing for the impacts of corruption on the official economy, they find that the non-observed economy can be both: a complement – growing in the same proportion of the official activities – and a substitute – when non-observed sector absorbs part of the official economic activities and compete for resources – these depend on the market context. These findings are relevant since they allow to conclude that shadow economy cannot be eradicated without understanding if it comes as a complement or instead, as a substitute, of formal activities. Moreover, reducing the size of the non-observed economy without fighting corruption is counterproductive. More recently, Dreher and Schneider (2010) test for the hypothesis that corruption and shadow economy are substitutes in high income countries while being complements in low-income countries and find little support to their premise. Nonetheless, these authors also stress the non-negligent relationship existing between corruption and institutions quality which is in line with the previous authors results on this subject.

According to Schneider and Enste (2002), their empirical analysis is not conclusive on the effects of non-observed economy on economic growth. On the one hand, it is possible to conclude that a decreasing non-observed sector enhances tax

revenues, making it possible for government to increase public spending which, in turn, can result in improvements on infrastructures and services, essential for promoting economic growth. On the other hand, the authors stress that there is some evidence supporting the hypothesis that the non-observed economy is more competitive than the formal economy, also being able to stimulate economic growth. Furthermore, earnings originated in the non-observed economy are spent in the formal economy, thus stimulating the economic activity by increasing private consumption. Hence, Schneider and Enste (2000) identify the vicious circle in which economies can step into due to increasing non-observed sector: increasing taxes is an incentive for economic agents to take the "exit option", and become part of non-observed economy. In turn, a greater non-observed economy erodes fiscal revenues and worsens the public deficit, leading to the gradual weakening of economic and social conditions for growth.

3. Mechanisms relating the Size of Non-observed Sector and Inequality

Studies on non-observed economy do not explicitly link the size of the non-observed sector to changes in inequality. In fact, this effect is rather neglected in the literature. Schneider and Enste (2000) found that an increasing non-observed sector is positively related to high taxes and high social transfers. This implies that, on the one hand, by presenting high levels of taxation, the economies are encouraging lower-income social classes to move towards non-registered activities that, by not complying with regulations nor taxes, are less expensive, and hence more profitable. This argument states that agents may find more benefits from producing in such activities, thus increasing the size of non-observed economy. Similarly, high social contributions discourage formal labour. On the other hand, relying on the redistributive function of the state (see, *e.g.*, Musgrave, 1960, Tanzi and Schuknecht, 2000), the expected outcome that can derive from high taxes and social transfers is a more efficient functional income distribution by the government, thus reducing income inequality. Put together, these arguments lead to the conclusion that a more equal distribution of income leads to an increase in the size of the non-observed sector.

However, once income inequality started being included in the analysis, recent literature has delivered results against this conclusion. Winkelried (2005) later found that higher government transfers reduce the size of the non-observed economy, which rejects Schneider and Enste's (2000) primary results. Besides, several studies cover different sets of non-observed economy. We will identify and explain the mechanisms relating income inequality and *NOE*, making explicit which type of *NOE* activities (following the OECD typology presented in Section 1, above) are relevant for each particular mechanism.

Some recent literature, more firm-oriented, reports that it is possible to link income distribution and the size of the non-observed sector through three main channels (*e.g.*, Mishra and Ray, 2010): (i) aggregate demand; (ii) corruption and (iii) productivity or efficiency. While the first channel explains the relation between inequality and non-observed economy, the remainders rely on the reverse causality.

Mechanisms operating from non-observed economy to inequality are the result of high levels of informality that arise significant economic distortions which affect income inequality. As recurring mechanisms there are (i) corruption; (ii) firm efficiency and (iii) wages. For the first, there is evidence that corruption is undeniably linked to the non-observed economy, (Choi and Thum, 2005). Second, firms' efficiency or productivity among observed and non-observed activities are significantly different (Busso *et al.*, 2012). Unproductive or inefficient firms cannot generate the same returns as the remainders, thus this affects wage distribution and income inequality. Third, wages are the most important indicator for income inequality and wage inequality relation with informality is rather not clear. On the one hand, when fighting inequality by rising minimum wages there is evidence for increase of non-observed economy (Canelas, 2014) while, on the other hand, policies and studies about lowering non-observed economy point towards more equally distributed incomes. Hence, this strengthens the importance of assessing the causality nexus between non-observed economy and inequality determinants.

3.1. Mechanisms Operating from Inequality to Non-Observed Economy

Mechanisms operating from inequality to non-observed economy are the result of unequal income distribution that may or may not promote higher levels of estimated non-observed economic activities.

The first channel in Mishra and Ray (2010) works mainly through the composition of aggregate demand and regards the set of non-observed economic activities that consists of underground production. Underground production, includes legal and productive activities that are deliberately hidden from the authorities, hence not being registered (OECD, 2002). Relying on the income distribution of consumers as the main determinant of demand composition and assuming that underground firms produce lower quality and more affordable goods, higher inequality will encourage underground firms to prosper since cheaper products dominate the consumption basket of lower-income classes. Registered firms are thus less profitable in high inequality contexts, assuming that their products are more expensive and cannot be bought by the overall potential demand. In the same vein, Winkelried (2005) also enhances that the

decision for firms to become or not underground depends on the composition of the aggregate demand. The larger the middle class is, the more equally distributed income is and the less profitable it is for firms to become underground. In this context, families can afford to buy goods provided by registered firms. The argument relates demand environment with the decision for firms to switch towards the underground activity. Underground activities do not pay taxes nor benefit explicitly from any public good; they are profitable only if the demand is sufficient to meet their production and usually set more competitive (lower) prices. In turn, demand for *NOE* goods mainly depends on income distribution of consumers. Since low income classes are prone to cheaper goods, consumers must enjoy a sufficiently high standard of living in order to discourage firms to go underground. According to the author's view, underground activities result from a non-equitable distribution of income which pushes firms towards informality. The author complements these arguments by illustrating that the level on income influences non-observed economy. He uses two different proxies for income inequality, mentioning that GDP *per capita* is far from being an effective measure of income or even development due to the significant share of GDP that arise from a little number of firms. First, the author relies on the Gini Coefficient to find a positive link between the size of the underground activity and income inequality. Second, he performs a similar analysis using the size of the middle class as a proxy for income inequality which is represented through the share of total income belonging to third and fourth quintiles of the distribution of income; in this case, results point towards a negative link between the two, *i.e.*, the larger the size of the middle class the smaller is underground activity. Winkelried (2005) provides evidence that a higher GDP *per capita* relates to a lower underground sector and that higher transfers reduce non-observed sector, which rejects Schneider's (2005) premise that indicated an opposite relation between transfers and informal activity. The authors also enhance the effective role that higher taxes play in reducing non-observed economy along with a concentrated income distribution towards the middle class*, i.e.* lower income inequalities. This evidence was provided using data for Mexico, between 1992 and 2002 through OLS regressions.

More recently, Benjamin *et al.* (2014) also provide evidence for the fact that larger informality means lower productivity. As a result, lower productivity leads to lower average wages. Therefore, the more unequal distribution of firms between formal

and informal activities, the more unequal will be income distribution. Thus, the more underground firms there are, the greater will be income inequality according to these arguments, which may also support the reverse order of causality.

The studies that follow cover the broad definition of non-observed economy, *i.e.*, including all the sets of not registered activities identified in section 1. Chong and Gradstein (2007) claim that more developed countries, where income distribution is less unequal and institutions have more quality, observe a smaller non-observed sector. Hence, raising the importance of countries stage of development for the assessment of mechanisms operating between income inequality and non-observed economy. The authors propose a theoretical model in which they show that non-observed economy is positively related to income distribution. This positive link is based upon the fact that the economy may create an environment prone to lower benefits that are entitled, conditional on formal records, to the poorer classes, thus encouraging shifts towards activities in the non-observed sector. This environment may derive from increases in taxes or from poor quality of institutions. The authors also find that the relation between the two is more preeminent when governments fail to provide quality services for their population. In fact, institutions can be an endogenous decisive factor for this causality nexus, as institutions are the authority that stands between the governments and the economic agents. Hence, quality institutions can guide and support the functional distribution of income among the lower-class individuals and the poor, reducing poverty and, in turn, income inequality. Moreover, the authors also included labour rigidities as one of the independent variables due to the strong links that arise from labour markets with income distribution and with non-observed labour which, in turn, is also an important part of the non-observed economy. As an example, according to Bertoli and Farina (2007), income is more equally distributed in formal labour markets than in non-observed labour markets (probably because of progressive tax corrections), hence linking inequality with increases in the non-observed labour. It is also clear that a lower wealth endowment, characterizing poorer countries, is positively related to large estimates for the non-observed economy. Moreover, Chong and Gradstein (2007) show that labour rigidities and the tax burden lose statistical significance in explaining non-observed economy, when regressors also include the Gini Coefficient capturing income inequality. This confirms that income inequality has an important role on determining

the size of the non-observed economy. However the impacts of income inequality vary depending on the methods used to estimate the size of the non-observed economy (see section 2.1, above). The study covered estimations following the macro-electrical and the demand for currency approaches, which had different values for the size of the non-observed economy. In fact, the macro-electrical approach presents an average of 28% of the overall GDP of the sample, 11% for industrial economies and 40% for developing countries; the currency demand presents and average size of the non-observed economy of 32%, in which developing countries have an average of 36%. The authors highlight the U.S as the country with the lowest estimation – 9% of GDP, and Bolivia owning the highest percentage – 67%. Although the estimations are different, the estimated correlation between the two is about 96%. Both estimations cover the 1990's. As for the results, both proved to have the same direction, although the intensity of the impact varies significantly. According to the authors, an increase of the Gini Coefficient from 0.49 to 0.57 (which means an increase in inequality) leads to an increase of the size of the non-observed economy by 3% using the demand for currency approach and by 9% using data from the macro-electrical approach. While the results remain consistent with each other, this information reveals the importance of the approach used to estimate non-observed economy for any analysis. Regarding the quality of institutions the results proved to be consistent with the hypothesis of an inverse relation with non-observed economy regardless of the proxy used and the set of non-observed economy estimations. Their empirical method controlled for this issue using aggregate governance, corruption, rule of law, bureaucratic quality, government stability and democratic accountability. This study included data for 86 countries during the 90s.

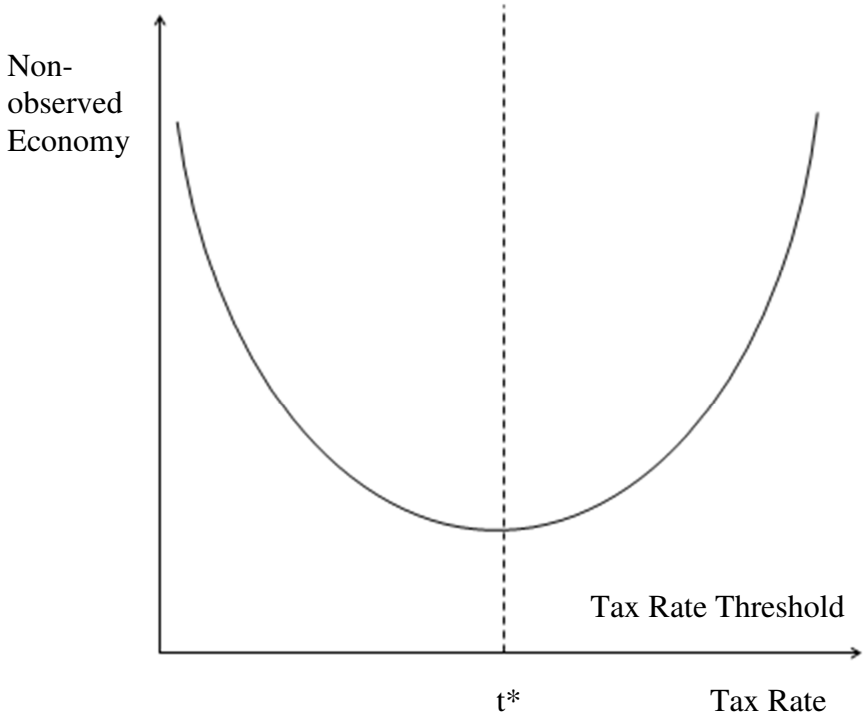
Rosser Jr. *et al.* (2003), focusing their work on a sample of 18 transition economies with data from 1989 to 1994, have also found that other potential determinants of non-observed economy lose statistical significance when adding inequality. This finding is essential since the largest estimated increase in the non-observed economy belongs to transition economies. The authors estimate the impacts on the size of the non-observed economy using two alternative models. In the first model, the Gini Coefficient is used as a regressor, together with indexes of democratic rights and economic freedom, unemployment rates, cumulative decline GDP (adjusted for estimated changes in the non-observed sector) and the maximum annual rate of

inflation. In the second model, they perform exact the same regression but exclude the Gini Coefficient from the set of explanatory variables. They conclude that, in the first model, Gini Coefficient is the only statistically significant variable (5% significance level) to explain increases in the non-observed sector. In the second model, only the maximum annual rate of inflation is statistically significant at 1%. Despite not being statistically relevant, the other variables exhibit a positive estimated effect on non-observed economy. Their study also concludes by stressing the importance of the quality of institutions for the size of *NOE*, which is in line with Chong and Gradstein (2007) findings. Moreover, the authors also found that tax reductions depress economies since they lead to losses of fiscal revenues and do not significantly contribute to decrease non-observed economy. Once more, the primary evidence of taxes as one of the most important determinants of non-observed economy is rejected by these authors.

One may associate, albeit with reservation, that taxation and its corresponding conversion into transfers may enhance income distribution. Dessy and Pallage (2003) demonstrate through a heterogeneous-agent model the ambiguous effect of taxation in the increase of the estimated size of the non-observed economy. In line with Schneider and Enste (2000), the authors also identify the level of taxation as one of the main determinants of non-observed economy. Reviewing previous works, the authors reinforce that, for a given increase in the tax rate, lower income classes have incentive to go underground, informal or illegal (according to our previous categorization) since they are unable to face such costs. This effect is more pronounced in poorer countries, enhancing that the more unequal economies are, the greater is the stimulus to increase the non-observed sector. However, the results from their model also demonstrate that tax decreases can also work in stimulating *NOE*. In fact, when decreasing taxation, the number of agents that are better-off in the non-observed economy rises according to their model. The economic explanation for this to happen is that for any tax level below the threshold – a value perceived as a tax equilibrium – any decrease sends the message that the contribution of the actual infrastructure is high enough as it is, allowing firms and individuals to be *free-riders*. The agents benefit from public goods but do not contribute, hence increasing the size of *NOE* through fiscal evasion, for example. This result contradicts the expected impact on the size of *NOE* of lowering taxes. This leads

the authors to the conclusion that there is a threshold for taxation below which *NOE* may rise due taxes reduction. Their model may provide an explanation for the statistically non-significant results obtained by Chong and Gradstein (2007) and Rosser Jr. *et al.* (2003) for taxes as an explanatory variable for the size of *NOE*, works that were previously mentioned in this review of literature. The figure below represents the results indicated by the authors on *NOE* due to tax changes.

Figure 2. Ambiguous behaviour of non-observed Economy regarding tax rates



Source: Self-made using explanations from Dessy and Pallage (2003)

In order to fully understand the depth of tax ambiguity, it is necessary to comprehend the motives for tax compliance. In this matter, Nicolaides (2014) argues that tax compliance will depend on three main factors: (i) consumption utility gained, (ii) the psychological externality payoff arising from social norms and finally (iii) the utility of the public good that it directly related with the quality of institutions.[1] In this context, the institutions represent, on the one hand, the benevolence through solidarity actions amongst society and, on the other hand, they also intervene with audits that

[1] Quality of institutions in the European countries can be assessed, for instance, through the European Quality of Governance Index (EQI).

intent to eliminate the tax compliance indeterminacy. In this analysis, institutions are a factor that influences the decision of individuals to whether or not pay taxes and elucidates the relation that is implied within the tax compliance and quality of institutions: more taxes mean more possibility to provide quality institutions and, in turn, this means quality public goods and increases of welfare. However this perception will ultimately depend on the audits performed by the institutions or, if these fail to succeed in the eyes of society, the social norms play the most important part. Thus, tax hikes can have ambiguous effects on the increase of the non-observed sector, depending, simultaneously, on the income inequality context that characterizes the country, together with social norms and quality of institutions. These results are in line with Dessy and Pallage (2003) model that also predicts ambiguous effect of taxes on *NOE*.

Furthermore, Singh *et al.* (2012) conclude that institutions are far more important for the determination of non-observed economy than taxes. Their analysis was build using non-observed economy estimations, governance and rule of law indexes for 100 countries that include advanced, emerging and developing economies for the year 2000. The authors find an inverse relation between increasing size of *NOE* and quality of institutions. Their findings rely upon the assumption that agents may benefit from underground activities not to avoid higher taxes but, instead, to avoid compliance with another variety of legal/bureaucratic obligations required by institutions, which are, in the agent's perspective excessively onerous (more so under high levels of corruption). This is consistent with precedent analysis of Schneider (2005) that had also revealed that the government's authority (considering that institutions represent, in fact, law enforcement) is a more important determinant of non-observed activities than taxes. Moreover, in countries with highly equal income distribution, or richer countries, lowering taxes can only be counterproductive when aiming at reducing non-observed economy, since the governments are only lowering their fiscal revenues with no visible effects on non-observed economy levels, since, according to this study taxes are not the most relevant mechanism to do so. Furthermore, this analysis is also in line with Dessy and Pallage (2003) argument about tax ambiguous impacts on *NOE*.

Mechanisms from inequality to *NOE* may also operate through the incentives for specific fiscal policies aiming at reducing inequality. Canelas (2014) studies the effects

of changes in the minimum wage on informality in Ecuador through a framework that assumes the following: (i) minimum wage is the strongest instrument to reduce inequality, establishing minimal earnings and living conditions for individuals; (ii) rises in minimum wage are followed by rises in wages in formal productivity hence, increasing unemployment; (iii) individuals that no longer work formal labour may enter one of the two categories: remain unemployed or work in the informal sector; (iv) informal industries are assumed to practice lower wages, as a result of increasing job demanders for the informal labour. This analysis was applied in Ecuador, where informal labour is estimated to be between 60%-80% and Gini Coefficient is near 0.49, a country exhibiting high levels of informality and inequality that needed to be understood. The study shows that, increases in the minimum wage satisfy the first three assumptions but fail to verify the fourth. In fact, higher minimum wages, besides increasing the averages wages and unemployment, were also increasing average wages for informal labour. The main conclusion is that, even in the informal industry, the minimum wage remains a benchmark for overall individuals.

To our analysis, this means that, fighting inequality through minimum wages may increase non-observed economy by raising the number of unemployed individuals willing to work in informal industries. Thus, high inequality may incentive public policies, such as minimum wages, that can lead to more non-observed economy. However, as evidence shows that the average wage increases in both formal and non-formal labour markets, this particular mechanism fails to corroborate the reverse relation – that more non-observed economy further increases inequality.

However there is evidence that in third world countries, namely Sub-Saharan African, where underdevelopment is so acute, even non-formal activities are seen as welfare and income-equality enhancing (Fox and Pimhidzai, 2011). Fox and Pimhidzai (2011) argue that the transformation of fundamentally agrarian countries and subsistence economies into urbanized, integrated and firm-dominated economies is the essence of the economic development. Their analysis focus on Uganda, which economy has shown to grow significantly over the past years and with important poverty reduction, although the available data fails to demonstrate this transformation. In fact, macroeconomic indicators were unable to provide information about this transformation that Uganda's economy experienced. For the authors, since these changes occurred

through informal production, this evidence contributes for the debate on the effects of increasing informality on welfare. Moreover, along with economic growth, the data showed that wages had been increasing, as well as the job supply, and fostered reduction of poverty. The paper explains that in this context, where the individuals' main job resource remain in farms (informal or self-production/consumption activities), the marginal benefit of working for non-formal, less efficient and low quality good industries is still attractive, thus employing numerous people. Moreover as the economy expands, more jobs are created encouraging wages to rise from the excess of job supply, hence reducing poverty. This specific context illustrates that, in fact, high unequal contexts provide conditions for increasing non-observed activities and, in turn, those same non-observed activities contribute to the decrease of inequality (reverse causality). Hence we conclude that the link highlighted in this section remains positive – more inequality means more non-observed sector – while the inverse is negative. In fact this analysis shows that under certain circumstances the increase in informal activity may boost the economy and reduce poverty and income inequality. However, inefficiencies and low quality products that results from non-formal activities may limit growth. In this specific case, the level of development of the economy is one of the main factors to take into account when making this assumption, since it is yet to be verified in more developed countries. The paper concludes by raising the question if this growth structure is sustainable overtime, once informal productivity does not bring any improvement in other sectors, according to these authors.

As a conclusion to this section, the main mechanisms that seem to operate from inequality to *NOE* are: (i) income inequality itself represented through Gini Coefficient on which the literature seem to agree on co-movement between the two, primarily caused by high unequal income distribution; (ii) firm environment that encompasses the formal or informal firms in an economy which results from the (iii) demand environment, which, in turn, may be represented through Gini Coefficient or percentage of middle class income individuals; (iv) quality of institutions seem to play a decisive role as it is the entity that stands between authorities and individuals and is responsible for policy compliance; (v) labour market are also listed in the literature since it establishes a strong link between income revenues obtain through formal or informal labour and the overall state of the economy, although the main studies that included this

variable showed it not to be statistically relevant as a determinant of the size of *NOE*; (vi) increases on minimum wage that seem to operate only from inequality to *NOE*; (vii) social transfers to individuals on which there are no consensus and finally, (viii) taxes which brings a debate on their ambiguous effect on the size on the *NOE* and their undeniable link with quality of institutions, which in turn, are responsible for tax compliance in some authors perspective.

The following table provides an overview of the main findings on this subject.

Table 2. Overview of mechanisms operating from income inequality to the size of non-observed economy

Author(s)	Mechanism(s)	Direction	Sample
Mishra and Ray (2010)	Composition of aggregate demand • (+) unequal income distribution	(+) *Ineq* causes (+) *NOE*	Developing countries, 2002-2006
Winkelried (2005)	Composition of aggregate demand: (-) Middle class	(+) *Ineq* causes (+) *NOE*	Mexico, 1992-2002
Chong and Gradstein (2007)	(-) institutional quality	(+) *Ineq* causes (+) *NOE*	86 countries, 1990-2000
Rosser Jr. *et al* (2003)	(-) institutional quality	(+) *Ineq* causes (+) *NOE*	18 transition countries, 1989-1994
Dessy and Pallage (2003)	(+) taxes	(+) *Ineq* causes (+) *NOE*	Theoretical Model – Heterogeneous agent-model
	(-) taxes	(+) *Ineq* causes (+) *NOE*	
Canelas (2014)	(+) minimum wage	(-) *Ineq* causes (+) *NOE*	Ecuador, 2000-2012 (developing country)

Fox and Pimhidzai (2011)	(+) economic activity	First: (+) *Ineq* causes (+) *NOE* Final: (+) *NOE* causes (-) *NOE*	Uganda, 1992-2009 (underdeveloped country)

3.2. Mechanisms Operating from Non-Observed Economy to Inequality

Mechanisms operating from non-observed economy to inequality are the result of high estimated non-observed economic activities that may or may not cause economic distortions that affect income distribution.

As regards the second channel in Mishra and Ray (2010) - corruption -, underground production (the first category of *NOE* following OECD typology) fosters income inequality. The corruption channel relies on recent findings that suggest that corruption feeds both the size of the underground sector and income inequality, hence creating a positive correlation between the two primarily caused by underground activities. In line with the conclusions of Rosser Jr. *et al.* (2003) and Dougherty and Escobar (2013), that also conclude for a potential positive link between *NOE* and corruption, their findings suggest that the prevalence of higher corruption increases non-observed labour; corruption reduces the benefits that arise from public goods, more so under weak institutions, and this discourages agents to demand for formal jobs. Mishra and Ray (2010) stress that, the more informal firms there are, the greater is the need for inspectors, thus lowering their average wage and increasing inequality. This argument relies on the assumption that everything else remains constant, including total expenditures with measures to control for the informal sector. Under this assumption, when working for a smaller wage, inspectors are more prone to accept bribes (which the authors name as bribe-demand), therefore increasing non-observed sector through corruption. The link with inequality is two-sided: *NOE* increases inequality as it increases the fraction of low-paid jobs and, consequently, inequality increases corruption, and thus increases non-declared income. The study is conducted in a sample of developing and developed countries and for the period covering from 2002 to 2006. To gather information about the demand for bribe, the dependent variable, the authors

rely on data available from World Bank Enterprises Surveys that groups data about business environment (confidence in judicial system; efficiency of government; business constraints; age of firms; size of firms, etc) and other sources to gather data about macro corruption perception (CPI) and corruption risk indicators (ICRG). They represent bribe demand through a dummy variable (1 for bribe; 0 otherwise). The assessment of the effect of corruption, which is represented, in this case, through bribe demand, results from running the equation twice: first, using non-observed sales with bribe demand; second, the same variable without bribe demand, the difference being the bribe demand. They conclude that corruption contributes to higher profits for informal firms since they are protected from enforcement by corrupted inspectors. The authors conclude that non-observed economy and corruption, in this context complement each other.

The last channel in in Mishra and Ray (2010) efficiency channel relies on the assumption that registered firms can generate more returns by being more productive and efficient; on the contrary, underground firms are less efficient, thus yielding lower returns. A premise that was also put forward by Benjamin *et al.* (2014). A large underground sector leads to lower average firms' returns, boosting inequalities. Thus, depending on the composition of firms, if registered firms are highly productive and efficient, it is plausible to expect that lower returns from the underground firms affect inequality. More recently, a research using Mexican data from 1998 until 2008 was able to quantify some distortions that informality brings to firm's productivity. In fact, Busso *et al.* (2012) found that factor productivity is lower for informal and illegal firms. This study estimated that one Mexican peso produces more 28% and 50% if allocated to formal firms than if it is allocated to illegal or informal firms, respectively. These results lead the authors to conclude also that informality contributes more than illegality to low productivity. However, when higher income distribution inequality is observed among consumers (first channel in Mishra and Ray, 2010), formal firms can be detained to enter the market due to high investment and wealth containment. In this context, underground firms can be more profitable than registered ones. Thus, revealing the importance of assessing the firm environment before making any assumptions on this channel.

Furthermore, Dessy and Pallage (2003) also found that registered firms benefit from a productivity premium that arises from formalization. This premium arises for firms that are complacent with the law alongside with high-quality institutions. Institutions of quality are crucial for the existence of the premium, since only registered firms can have access to such public good.

Other research for developing countries shows that less *NOE* may decrease income inequality. Using Brazilian data from 2002 up to 2007, Meghir *et al.* (2012) found that if authorities increase the costs for informal activities by raising fines through increasing detection and inspection measures, this would result in higher average wages and increased welfare. This particular mechanism is such that markets will become more competitive, once increasing the costs of informality produces stronger stimulus for firms to become formal. This competition among formal firms will push the wages and profit margins up from becoming formal and will more than compensate the costs that informal firms incur. However, declines in informality decreases inequality only up until a certain extent. In fact, the authors present some complex results when testing for the abolishment of informal activities. Overall, welfare will still increase, although firms' profits margins may increase or decrease, producing also ambiguous effects on wages – and, ultimately, on inequality. Ambiguity of effects depends on the market structure and economic contexts. Informal labour markets are assumed as growth promoters in developing countries (*cfr.* Meghir *et al.*, 2012). Economies may grow from non-observed activities whenever informal firms can benefit from lower producing costs by not complying with regulation. In this context, informal firms still operate and increase employment although they are less productive than formal firms.

Another study, using data for Russia from 2000 to 2010, also provides evidence that there is, in fact, difference between earnings in formal and in informal labour markets (Lukiyanova, 2015). This particular analysis concludes that earnings from informal labour are more prone to polarization, which leads to higher inequality. This study is consistent with the findings of Bertoli and Farina (2007) who advocated that there is a more equally wage distribution among the observed economic activities than among the non-observed, hence linking increases in inequality with the rise in informal labour. In particular, when testing for impacts of increases in informality on earnings

distribution, Lukiyanova (2015) finds that a 10% increase in *NOE* leads to a 1 to 5% increase in inequality. Although the results are relatively small, they are consistent with our premise that there is a causality nexus between the two. Furthermore, the author is able to assess that labour earnings inequality decrease through the decline of (i) hourly wage rates and/or (ii) working hours, which are the two factors that almost completely determine the evolution of earnings. For informal labour, the impact of working hours is more preeminent jointly with a higher dispersion of higher earnings. The definition of informal labour used in this study is consistent with the definitions provided by OECD that we are following along our work.

Other research, using Italian data from 2000 until 2004, suggests that increasing informal labour reduces formal wages which increases inequality (Elia and Di Porto, 2011). Elia and Di Porto (2011) also explain that informal work may be dominated by low-skill individuals; hence, reducing informal labour may lead to inequality decreases since workers may face higher levels of income by working in the observed economy.

A research from the IMF tests the hypothesis that increases of non-observed labour may contribute to wage responsiveness in high-regulated environments (Estevão and Filho, 2012). The amount of informal workers may increase to avoid over-regulated work conditions, hence linking non-observed economy, inequality and the role of institutions. Chong and Gradstein (2007) had already mentioned the importance of the link between these three factors, enhancing that the causal relationship between *NOE* and income inequality is more significant under weak institutions. However, the results in Estevão and Filho (2012) show that environments that are excessively institutionalized may also affect *NOE* and inequality in the same direction. This research mainly concerns wage flexibility in Brazil between 1981 and 2009, which the authors demonstrated to be correlated with higher institutionalization; the authors found that, compared with the formal market, wages in the non-observed labour market were significantly more sensitive to macroeconomic impacts such as unemployment rates.

Evidence from Turkey between 2005 and 2009 also reveals that informal hourly wages are more sensitive to macroeconomic environments (Baltagi *et al.*, 2012). Finally, another research conducted by the OECD also stresses that strong presence of institutions may lead to higher labour costs driving individuals towards informal labour, hence increasing *NOE* (*cfr*. Dougherty and Escobar, 2013). This latter study concerned

Mexican state data between 2005 and 2010 and controlled for other determinants of *NOE*, such as GDP, labour skills, differences among microenterprises, the cost to start up a business, foreign investment restrictions, the rule of law and finally corruption incidence.

At this point, institutions are in fact a recurring factor shaping the relationship between *NOE* and income inequality. Davis (2007), accounting for the negative link between growth and inequality, indicates that restrictive institutions act as barriers for agents to become formal; thus informality lowers growth as informal activities are less productive (Busso *et al.*, 2012) and increases income inequality.

As the literature seems to show, it is possible to observe a positive link between non-observed economy and income inequality, meaning that an increase in *NOE* may stimulate a hike on the second. For the wage mechanism this means that there is ambiguous evidence, depending on the causality nexus, on the nature of the correlation between inequality and *NOE*. First, Canelas (2014) argues that fighting inequality through rising average wages leads to a greater non-observed economy. Second, research on the inverse relationship brings evidence for decreases of inequality through fighting non-observed activities, namely informal labour.

The table below provides an overview of wages as a mechanism operating between inequality and non-observed economy:

Table 3. Impacts of wages on inequality and non-observed economy

Authors	Direction	Impacts on Inequality	Impacts on *NOE*	Relation
Canelas (2014)	*Ineq->NOE*	(-)	(+)	Inverse
Meghir *et al.* (2012)	*NOE->Ineq*	(-)	(-)	Co-movement
Lukiyanova (2015)	*NOE->Ineq*	(+)	(+)	Co-movement
Elia and Di Porto (2011)	*NOE->Ineq*	(+)	(+)	Co-movement

Through this overview it is possible to conclude that wages as a mechanism operating from non-observed economy to inequality are most likely to generate a co-movement between the two. When operating from inequality to non-observed economy, although, evidence relying on in a single study apparently generates an inverse relation. More robust evidence is thus in order regarding the last causality nexus. Wage mechanism should be assessed accounting for the two important factors: (i) the direction of the causality nexus between *NOE* and inequality and (ii) the nature of co-movements between both.

Alternatively, there is an interesting approach of Binelli and Attanasio (2010) that proves the existing relationship between non-observed economy and income inequalities. In fact, their analysis explains that wage inequality increases simultaneously as the informal activity increases in Mexico, using data from 1987 up to 2002. To do so the authors observed the percentiles activity of Gini hourly real wages amongst informal workers and formal ones over the years that allowed them to better observe dispersion. Hence, the conclusion was that inequality is always higher for informal workers than for formal ones both at the bottom and top of wage distributions. This means that informal workers, even the ones on less unequal positions (lower Gini hourly wage) are still more unequal than formal ones. Besides giving evidence between the non-observed economy and inequality, this analysis allows to illustrate clearly the divergence of behaviours of these variables. On the one hand, more informal activity leads to more unequal wage distribution and on the other hand more unequal wage distribution promotes higher non-observed activities.

Table 4. Overview of mechanisms operating from non-observed Economy to inequality

Author(s)	Mechanism(s)	Direction	Sample
Mishra and Ray (2010)	(+) corruption (-) productivity of informal firms	(+) *NOE* cause (+) *Ineq*	Developing countries, 2002-2006
Meghir *et al.* (2012)	(+) Wages Costs of informality	(-) *NOE* cause (-) *Ineq*	Brazil, 2002- 2007
Lukiyanova (2015)	(+) Hourly wage inequality	(+) *NOE* cause (+) *Ineq*	Russia, 2000-2010

Elia and Di Porto (2011)	(-) wage of low-skilled	(+) *NOE* cause (+) *Ineq*	Italia, 2000-2004
Estevão and Filho (2012)	(+) informal labour ---------- (-) quality of institutions	(+) *NOE* cause (+) *Ineq*	Brazil, 1981-2009
Binelli and Attanasio (2010)	(+) hourly wage inequality	Both Directions	Mexico, 1987-2002

4. Empirical Application

As we have seen in the previous chapters, the related literature suggests that the mechanisms operating between the two variables, *NOE* and inequality emerge mostly in developing countries. Indeed, most of the empirical literature covers groups of transition and emerging economies, or individual emerging. Several contributions show this fact for example, for Mexico, Winkelried (2005), Dougherty and Escobar (2013) and Busso *et al.* (2012); Russia in Lukyianova (2013); Brazil in Estevão and Filho (2012) and Turkey covered by Baltagi *et al.* (2012). Mishra and Ray (2010) also include developing economies their analysis (the sample gathers data also for developed countries). Rosser Jr. *et al.* (2003) also find a causal relation between the two variables for a sample of 18 transition economies. All studies are consistent with one another since the time range and the findings are rather similar, and they consensually sustain the existence of a strong relationship between income inequality and *NOE* for developing countries. The methodology used in Rosser Jr. *et al.* (2003), with a sample covering the time span 1989-1994, using OLS regression interchanging non-observed economy and Gini Coefficient as dependent variables, and allows the study of possible reverse effects: the authors first test the non-observed economy as the dependent variable and, second, choose the Gini Coefficient in the same position, using the same control variables. The other variables taken into consideration in this analysis were: economic freedom, adjusted cumulative decline of GDP, maximum annual rate of inflation, democratic rights index and the unemployment rate. Later, Chong and Gradstein (2007) include the effect of institutions by using the ICRG – International Country Risk Guide – index, instead of the democratic rights index. According to the authors, this index is more encompassing since it compiles data about the country's political, economic and financial risks and institutions that, as shown in the literature review, above, correspond to one of the most relevant mechanisms beneath the relationship *NOE*-inequality.

For developed economies little evidence exists on this subject. Moreover, neither theoretical nor empirical results presented in the literature are able to provide a clear overview of the relationship for different level-of-development regions or by type of countries. In fact, considering the countries covered by the papers reviewed before,

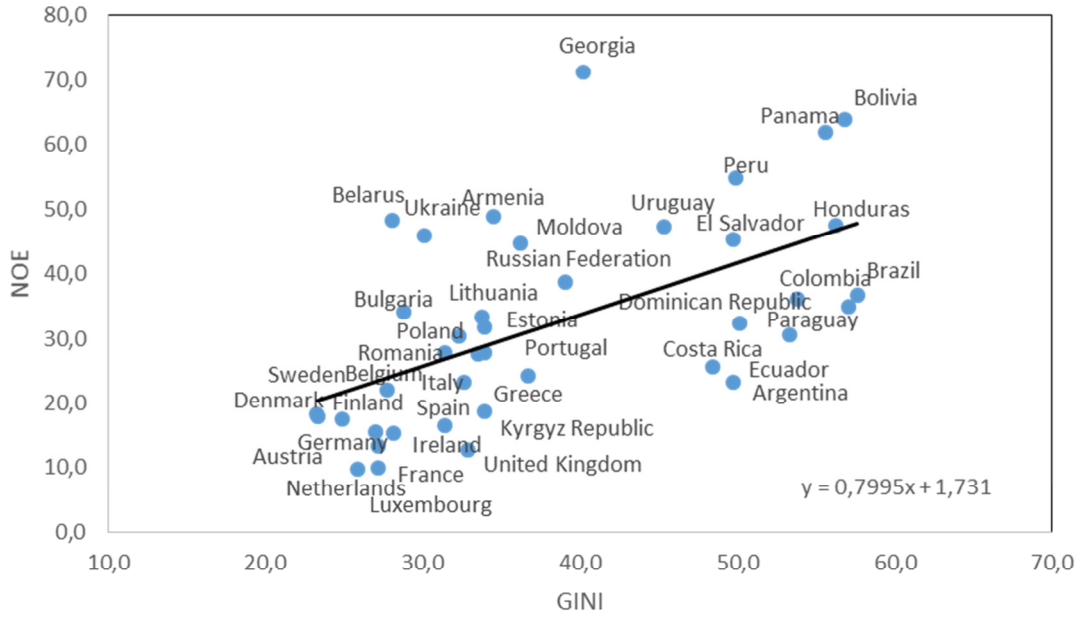
we cannot clearly distinguish differences in the relationship between *NOE* and Inequality categorized by country type or country groups. Since the economic structure of both groups (emerging and developed countries) is quite diverse, the relation of *NOE* and Inequality may not materialize alike for different characteristics of these economies. As the evidence shows, developed countries tend to have lower *NOE* estimations accompanied by lower income inequality and, reversely, emerging and developing economies tend to present higher estimations for both variables. Hence, it seems relevant to separate our data by groups of countries in order to overcome this shortcoming in the literature.

The empirical application we propose in this chapter intends to be a contribution for the existent findings, namely by providing a categorization of results by country groups – developed and transition/developing countries - and to extend the analysis using the most updated data available. We will firstly explore the direction of causality nexus between *NOE* and Inequality for the two groups of countries and, secondly, provide a detailed analysis on the qualitative nature of such relationship(s).

4.1. Causality Tests – Methodology and data description

Our literature review aimed at encompassing all the main findings regarding the relationship between Inequality and *NOE*. However, to the best of our knowledge, no study enhances the causal relationship between these two variables. It is rather evident that the two phenomena evolve similarly: higher estimation values of the non-observed economy come along with higher income inequalities. The following figure enhances this strong positive correlation between the two variables, by taking the average values for 40 countries for both the Gini Coefficient and *NOE* estimates, during the period 1995-2009.

Figure 3. Correlation between Gini Coefficient and *NOE* estimates, average 1995-2009



Source: Authors' own calculations based on data from the Worldbank and the Eurostat (accessed on July 2015).

We will use Granger Causality Tests to draw conclusions on the causality nexus between *NOE* and income inequality: are higher inequalities promoting higher non-observed economies as a mean for lower income classes to improve their revenues? Or, on the contrary, is a higher non-observed sector creating economic dysfunctions that amplify bias in income distribution? Hereafter, we will refer to Income Inequality as *Ineq* and non-observed economy as *NOE*.

The idea beneath using Granger Causality tests is to assess whether a certain economic series observed in the past affects another in the present. However, the question of causality is full of controversies since "everything causes everything" (*cfr.* Gujarati, 2009).

The concept of precedence or predictive causality relies on the assumption that an economic time series contains useful information that allows predicting another economic time series. This way, this Granger Causality test assumes that all information relevant to the prediction is contained on the two economic time series. This method allows us to verify if *Ineq* contains useful information that predicts *NOE*, or on the

contrary, if it is *NOE* that is able to cause *Ineq*. The method corresponds to the estimation of the following equations:

$$(4.1) \quad Ineq_t = \sum_{i=1}^{m} \alpha_i \; Ineq_{t-1} + \sum_{j=1}^{m} \beta_i \, NOE_{t-j} + \lambda_1 t + \mu_{1t}$$

$$(4.2) \quad NOE_t = \sum_{i=1}^{m} \gamma_i \, NOE_{t-i} + \sum_{i=1}^{m} \delta_i \, Ineq_{t-j} + \lambda_2 t + \mu_{2t}$$

The μ_t represents errors that we assume are uncorrelated with the two parameters under analysis. Unidirectional causality from *Ineq (NOE)* to *NOE (Ineq)* is indicated if the estimated coefficients on the lagged *NOE (Ineq)* in 4.1 (4.2) are statistically different from zero as a group and the set of estimated coefficients on the lagged *Ineq (NOE)* is not statistically different from zero. Feedback, or bilateral causality, is suggested when the sets of *Ineq* and *NOE* coefficients are statistically significantly different from zero in both regressions.

The test runs these equations for the two economic time series and retrieves results that express the statistically significance of all the coefficients. Granger causality test assumes that variables are stationary. The interpretation on the results is done by looking at the *F-stats* (or *p-values*) in order to assess overall statistically significance of the several coefficients. In particular, and since we use annual data, we include only one lag.

Since the purpose of our analysis is to assess the direction of a hypothetical relation between *NOE* and income inequalities we will use *NOE* estimates in percent of GDP as one economic time series and Gini Coefficient estimates as a proxy for income inequalities being the second economic time series. Additionally we will categorize the countries amongst our sample by income levels according to World Bank's criteria. This classification is important to allow assessing the causality relation across different groups of countries. Moreover, in order to add value to our research, we will also run the test using tax evasion and self-employment estimates in percent of GDP as more detailed proxies for *NOE*. These variables are some of the many forms taken by *NOE.* This test will assess its causal direction with Gini Coefficient. This complementary test intends to provide an exploratory explanation of the dynamics between forms of *NOE* and income inequality.

To run our Causality tests we have built two panels: one that gather information for 40 countries from 1995 up to 2009, categorized by income level; and another panel which contains data of 19 countries from 1999 up to 2010 to test causality using tax evasion and tax evasion accounting for self-employment. The software *E-views* was used to run the tests.

- *NON-OBSERVED ECONOMY*

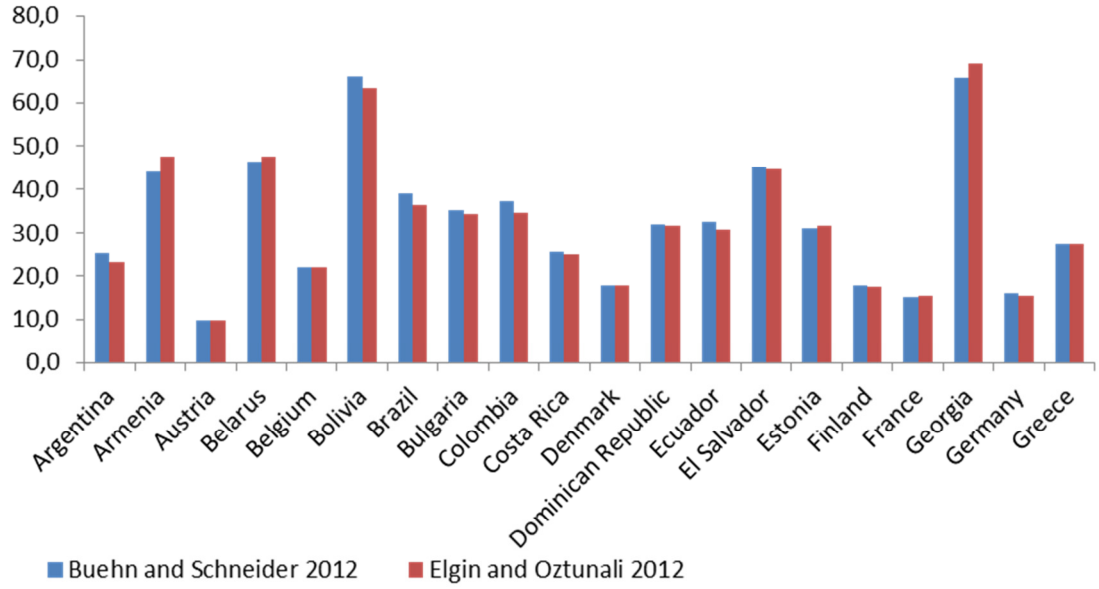
Some recent studies used Buehn and Schneider (2012a) latest estimations. However, their estimations only cover the years from 1999 up to 2007, leaving out most recent. Furthermore, we consider that a sample counting only on 9 observations by country is not the most desirable sample to apply causality tests, since it may not encompass important economic information and features that derive from economic cycles. This is an important consideration since *NOE* is estimated in percentage of GDP, and GDP increases and decreases at different rhythms during economic cycles. Most up-to-date data available concerning *NOE* results from the estimations of Elgin and Oztunali (2012), a study that covers the period from 1950 up to 2009, providing a much greater window of data to our sample. We may refer, however, that the method used by both studies are rather different. Elgin and Oztunali (2012), as referred in the previous sections, used a two sector model in which they were able to back-out time-varying estimations in percentage of GDP of the *NOE* for each country. The authors identify their model as a new approach not based on econometric specification or assumptions which may lead to errors (Elgin and Oztunali, 2012). To reach these results, the authors start by drawing a model and solving it in steady state; then, they calibrate the different parameters of the model to match the observable and available data for the countries. Finally, after calibrating the parameters, they run their *NOE* equation and estimate the size of the *NOE* in terms of GDP.

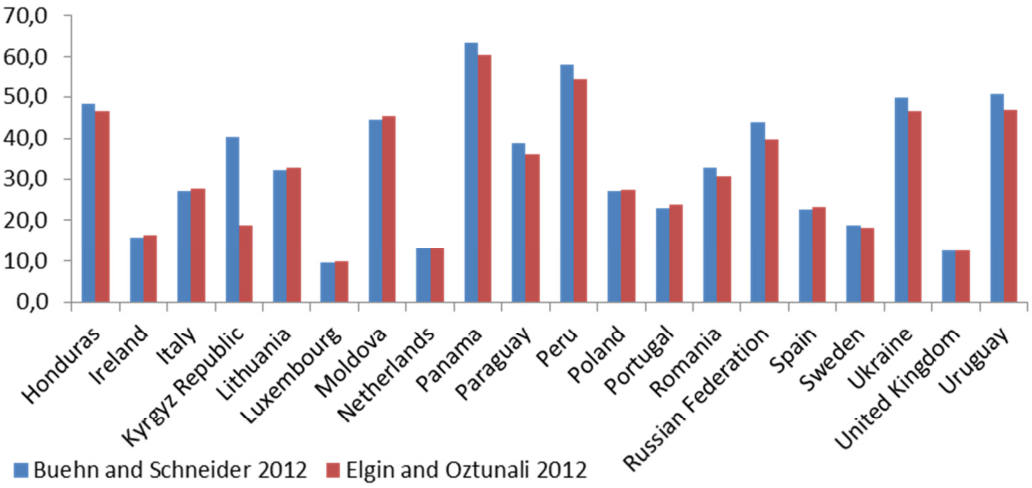
Buehn and Schneider (2012a) used a Multiple Indicators Multiple Causes (MIMIC) Model, which consists, in this particular case, in retrieving information about the size of the *NOE* by relying on observable and non-observable data and information. The non-observable variable (*NOE*) is linked to indicators and explanatory parameters through analytical and structural models designed by the authors. First, the authors establish the causes and indicators of *NOE*; then, following the relationship designed

between them and *NOE*, the authors are able to back-out the coefficients of the various indicators and by this way, estimate *NOE*.

Chong and Gradstein (2007) provided evidence that the amplitude of effects of income inequalities in the determination of *NOE* may vary according to the *NOE* estimation method used for the analysis. Hence, it is mandatory to check if both databases are significantly different from each other in order to avoid gaps in our research. Therefore, to be more robust in the choice of the data, we assess the correlation regarding both estimations for the interval that includes the same years (1999-2007) and the same 40 countries. Both estimates present a correlation of almost 1 (96%), which means that the estimated values of these studies are strongly correlated. Additionally, we have compared the average values for each country (see Figures 4): the averages are rather similar except for the Kryzyg Republic. Since Elgin and Oztunali (2012) provide a larger dataset, we choose to use the later in detriment of Schneider and Buehn (2012) estimates.

Figures 4.1. and 4.2. Comparison of *NOE* averages of the estimates of Buehn and Schneider (2012a) and Elgin and Oztunali (2012) for 40 countries and for 1999-2007





Source: Authors own calculations based on data from Schneider and Buehn (2012) and Elgin and Oztunali (2012).

- *GINI COEFFICIENT*

Regarding income inequality, and in line with the literature, we will use Gini Coefficient as a proxy. In fact, this measure is widely used to measure income inequality. Many studies use the database computed by Deininger and Squire (1996); however, this database does not contemplate every year for each country and has some duplicated data (different indicators) for a given year and country. Hence, in order to avoid these shortcomings, we have chosen the Gini Index estimates provided by the World Bank. This index estimates the extent to which disposable income distribution among the population of a certain economy deviates from the situation of perfect equal distribution. The Lorenz Curve is a charted representation of the quantitative relationship between the percentage of income recipients and the percentage of total income they received during a certain period of time. The more distant is the curve from the perfect equality (45º degree) line, the more unequal is a given economy. The Gini Index measures the distance between the actual distribution of income (Lorenz Curve) and the line of perfect equality. Thus, the lower (higher) the Gini Coefficient, the more (less) equally distributed income is (see *e.g.* Gastwirth, 1972).

Since the World Bank database lacked some crucial data, namely for European countries, we first gathered information from the Eurostat for the European countries

and covered all the remainders using data from the World Bank database. This last data source only provided data from 1995 and did not cover all the years for every country. In order to overcome this gap, we defined as a criterion to keep sets that covered at least 2/3 of the years between 1995 and 2009. Thereby, our sample uses Eurostat estimates for Gini Coefficient regarding the following countries: Austria, Belgium, Bulgaria, Germany, Estonia, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Romania, Sweden and United Kingdom, and World Bank estimates for the reminders.

It is important to note that Eurostat estimates for Gini Coefficient refer to equalised disposable income for households, meaning that income is weighted depending on the number and age of individuals that are members of a household.

- *INCOME LEVEL*

Since the literature review we have developed clearly shows that most related studies focus on developing countries, we will implement causality tests considering three samples: (i) all data available; (ii) high-income countries and (iii) low-income countries.

To divide the countries by income level, we follow the categorization proposed by the World Bank: lower, lower middle, upper middle and higher income levels based on GNI (Gross National Income) *per capita*, converted in USD through the Atlas method. The thresholds are updated every year the 1st July along with the classification of the countries by income level. This means, that at present time, we know both the threshold for the year 2014 and the countries classification.

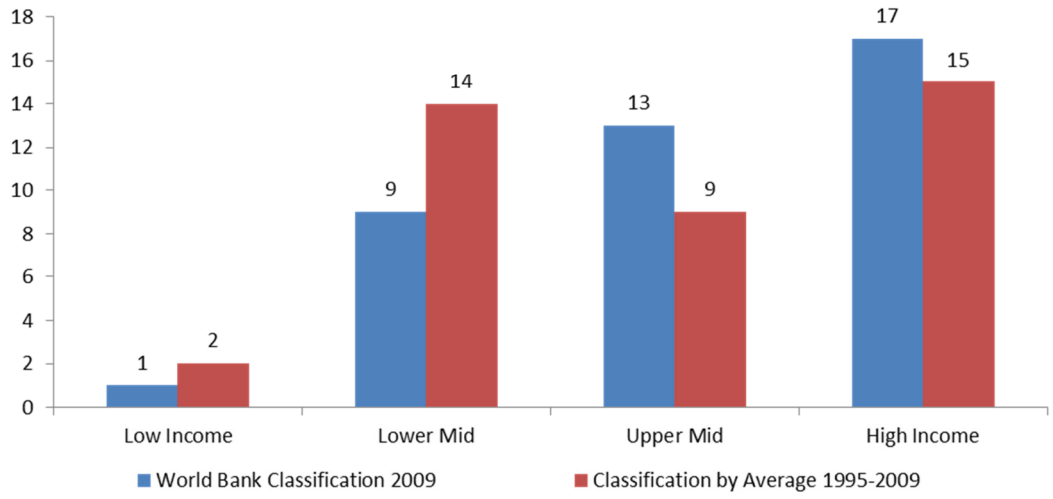
Table 5. World Bank Analytical Classifications

GNI per capita in USD	2009	2014
Lower Income (L)	<= 995	<=1.045
Lower Middle Income (LM)	996-3.945	1.046-4.125
Upper Middle Income (UM)	3.946-12.195	4.126-12.735
High Income	>12.195	>12.735

Source: *World Bank Historical Analytical Classifications* (http://data.worldbank.org/about/country-and-lending-groups, 18/08/2015).

However, since our data only covers up to 2009, we will consider the thresholds for that year. We also compare the groups of countries that emerge by computing the average values of GNI per capita for the time period 1995-2009 and the groups associated with the categorization made by the World Bank.

Figure 5. Number of countries in our sample by income class: World Bank Classification vs. average values



Source: Authors own calculations.

The figure shows that when categorizing the countries with GNI per capita averages during 1995-2009, there are more lower-middle class countries and less upper-middle class. This difference results from the fact that emerging and transition countries like Belarus, Bulgaria, Dominican Republic, Peru and Romania have been upgrading their status over the years. We will maintain the categorization using the averages and the 2009 threshold since it is more adequate to consider all the relevant information regarding the evolution of the economies during these years. Therefore, our categorization is as follows:

Table 6. Countries by income level using averages for the time period 1995-2009 and the World Bank 2009 threshold for GNI per capita in USD

Lower Income	Lower Middle	Upper Middle	Higher Income
Kyrgyz Republic	Armenia	Argentina	Austria
Moldova	Belarus	Brazil	Belgium
	Bolivia	Costa Rica	Denmark
	Bulgaria	Estonia	Finland
	Colombia	Lithuania	France
	Dominican Republic	Panama	Germany
	Ecuador	Poland	Greece
	El Salvador	Russian Federation	Ireland
	Georgia	Uruguay	Italy
	Honduras		Luxembourg
	Paraguay		Netherlands
	Peru		Portugal
	Romania		Spain
	Ukraine		Sweden
			United Kingdom

The countries that we will consider as lower income are those listed as low income and lower middle, and the countries considered as higher income are the ones listed as upper middle and high income.

Alternatively, we will test for countries that present *NOE* estimates higher and lower than 40% which, *a priori*, correspond to low-income countries and high-income countries, respectively. Indeed developed (developing) countries are characterized by low (high) *NOE* indicators in the literature.

- *TAX EVASION*

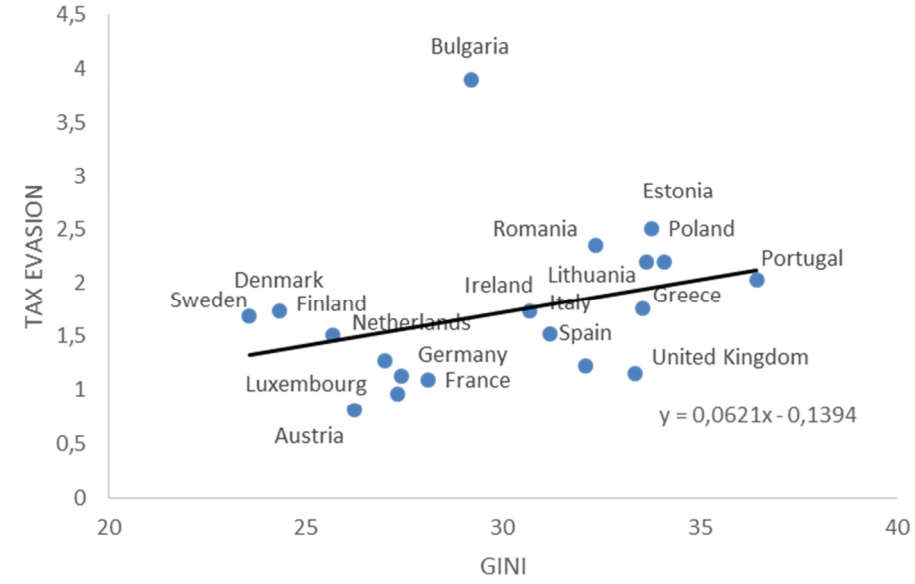
The effect of taxes on income distribution and on the size of *NOE* is one of the recurrent mechanisms covered in the literature. In fact, numerous authors emphasized the argument that increasing taxes is a stimulus for increasing non-observed activities, namely through tax evasion. Other authors mention an ambiguous effect, which emerges because higher taxes also mean that citizens are contributing for a greater quality of public service and institutions. Hence, the income redistributive function of the state is associated not only to lower income inequalities but also to higher quality of public institutions, which may prevent informal activities from increasing.

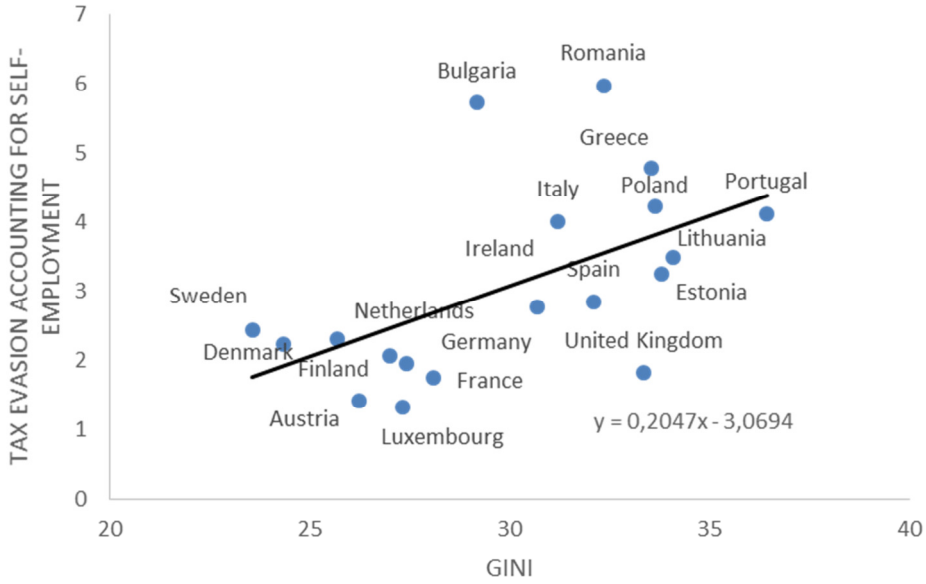
We will also test for causality nexus using tax evasion estimates of Buehn and Schneider (2012b) for 19 OECD countries, during the years 1999 up to 2010. Their tax evasion estimates focus on legal activities, but illegally hidden, leaving aside criminal

activities. The tests will, firstly, assess whether it is tax evasion that fosters income inequality and, secondly, if it is income inequality that causes tax evasion. These data also contain estimations covering tax evasion associated with self-employment, since the authors found that self-employment is also a determinant of tax evasion. Self-employment may significantly account for income that derives from unreported activities. Buehn and Schneider (2012b) mention that this type of non-observed activity is one of the main contributors to *NOE*, additionally stating that it is less controllable by the government and is ambiguous from a welfare point of view. In fact, self-employment may act as an alternative source of income in some cases, therefore contributing for a greater overall welfare. The following figures represent the relation of tax evasion and tax evasion accounting for self-employment with the Gini Coefficient. The values are averages from 1999 up to 2010 for both variables.

The charts are able to illustrate the positive relation between the two, *i.e.*, larger levels of tax evasion are positively correlated with Gini Coefficients, hence, with higher inequality (see Figures 6). In fact, the trend line obtained through the regression between Gini Coefficient and tax evasion has a smaller slope than the second which considers tax evasion that also accounts for self-employment. In fact, this chart may give primary evidence that tax evasion will not affect income inequalities or vice versa, since, at this point we do not know the direction of the causal nexus between inequalities and *NOE* or forms of *NOE*. Figure 6.2. shows a much greater slope which may lead to the conclusion that independent from the causal direction, this relation will more significant.

Figure 6.1. and 6.2. Relation between tax evasion and Gini Coefficient, average 1999-2010





Source: Authors own calculations using data from the World Bank and Buehn and Schneider (2012b).

Buehn and Schneider (2012b) offer estimates for tax evasion considering 38 countries, which are not the same that compose the sample we have previously considered. Therefore, in order to account for the causality nexus between tax evasion and income inequalities, we will make the match between the available data with our previous panel for Gini Coefficient estimates and build a new panel. This new panel

consists of 19 countries, for the time period 1999-2010 (Table 7). According to our previous categorization of countries by income, most of the countries in this new panel belong to the higher income group – which was expectable since the data only contained OECD countries – only Bulgaria is considered as a lower income country. Thus, for this specific case testing for different income groups does not apply. This leaves us with two panels: the first for the overall analysis which includes Gini Coefficients and *NOE* estimates of Elgin and Oztunali (2012) forming a sample of 40 (developed and developing) countries between 1995 and 2009; and a second panel build with estimations for tax evasion and tax evasion that accounts for self-employment of Buehn and Schneider (2012b) and Gini Coefficients form World Bank and Eurostat, a panel with data for 19 developed countries between 1999 and 2010.

Table 7. Countries included in the tax evasion panel data by income level

Lower Middle	**Upper Middle**	**High Income**
Bulgaria	Estonia	Austria
	Lithuania	Denmark
	Poland	Finland
	Romania	France
		Germany
		Greece
		Ireland
		Italy
		Luxembourg
		Netherlands
		Portugal
		Spain
		Sweden
		United Kingdom

4.2. Causality Tests – Analysis of results

Our empirical tests and results are divided as follows: first, we will run Granger Causality tests considering all data available (40 countries, 1995-2009). The second group of tests is applied to subsamples of high-income countries and of countries that present *NOE* estimations below 40% of GDP (developed countries). The income classification follow the World Bank's criteria; the threshold of 40% for *NOE* was set looking at the data and verifying that, excepting for few countries, most of the high—income countries exhibit *NOE* estimations below 40%. Conversely, the third group of

tests assesses the causal direction for low-income countries and for the subsample of countries that present estimated *NOE* above 40% of GDP.

The aim of the detailed assessment considering subsamples is to check whether the causal relation differs between more and less developed countries and infer if different types of *NOE*, typical of developed or developing countries, may explain such differences.

The late and fourth group of tests considers two forms of *NOE*– tax evasion (most important for developed countries) and tax evasion accounting for self-employment (self-employment being most typical of developing countries). Tax evasion estimates include all potential volume of taxes in percent of GDP that were not collected by the governments; tax evasion accounting for self-employment considers the portion of tax evasion that also results from individuals being self-employed. To perform this test, we built another panel that gathers information for 19 countries, between 1999-2010, using Schneider and Enste (2012b) estimations.

However, previous to conducting causality tests, we assessed the stationarity of the series *NOE* and *GINI*. A summary of panel unit root tests is shown in Annex II, for *NOE* and *GINI* and, in general, we can conclude for the stationarity of both series – we find evidence for unit root only in the case of the *ADF-Fischer Chi-square* test for the *GINI*.[2]

GRANGER CAUSALITY – FULL sample

When testing the causality nexus between *NOE* and *Ineq* considering the full baseline sample, the results from *E-Views* retrieve low *p-values* and high *F-Stats*, meaning that there is sustained evidence for causality in both directions (see Table 8). In fact, according to the tests, we reject both null hypotheses: H0 a) *GINI* does not Granger cause *NOE* and H0 b) *NOE* does not Granger cause *GINI*.

[2] Results are computed the full sample, and refer to the general measure of *NOE*.

Table 8. Granger Causality test results – *NOE* and *GINI*

Sample: 1995 2009
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GINI does not Granger Cause NOE	396	40.7044	5.E-10
NOE does not Granger Cause GINI		4.01446	0.0458

A higher enough *F-Stat* allows rejecting the Null Hypothesis. [3] In this case, we reject both hypotheses at 5% statistical significance, *i.e.,* the level of income inequality does "Granger-cause" the size of *NOE* and, simultaneously, the size of the *NOE* does "Granger-cause" income inequality, thus supporting bilateral causality. However, we must note that the first hypothesis - *GINI* causing *NOE* - is significant at 1% significance level, while and the second hypothesis - *NOE* causing *GINI* - is rejected for 2.5% and 1%. These results are in line with what the literature review suggested: income inequalities are more prone to cause *NOE* than the reverse (see, *e.g.*, Chong and Gradstein, 2007; Rosser Jr. et al, 2003; Dessy and Pallage, 2003).

GRANGER CAUSALITY – DEVELOPED COUNTRIES subsample

If we consider only the group of high-income countries, the results are shown in the following table:

[3] *F-Stat*: given the number of parameters and observations in this test, the degrees of freedom are (1, 391); since the Granger Causality test does not require intercept, the first degree of freedom is simply the number of parameters (k=2) minus 1; the second value corresponds to the number of observations minus 1. *F-Test* threshold values differ for different levels of significance: *e.g.*, 2.70 for 0.10, 3.84 for 0.05 and 6.63 for 0.01 (source: http://www.socr.ucla.edu/applets.dir/f_table.html accessed 18/08/2015).

Table 9. Granger Causality test results – *NOE* estimates for higher income countries and GINI

Sample: 1995 2009
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GINI does not Granger Cause NOE_HIGHER	262	4.08086	0.0444
NOE_HIGHER does not Granger Cause GINI		0.59549	0.4410

For this group of countries, the direction of causality runs only from *GINI* to *NOE*. This means that, despite these countries usually having low estimated *NOE* and low estimated Gini Coefficients (low income inequality), the mechanisms operating from inequality to *NOE* (institutional quality, taxes and composition of aggregate demand) still seem to explain the link between these two variables. In fact, looking at the results, the probability of *GINI* not "Granger-causing" *NOE* is below 5%.

If we use as a criterion to classify countries the estimated *NOE* over GDP, and proceed with the test considering only countries with values of *NOE* below 40% of GDP, the results are shown in Table 10:

Table 10. Granger Causality test results – *NOE* estimates below 40% countries and *GINI*

Sample: 1995 2009
Lags: 1

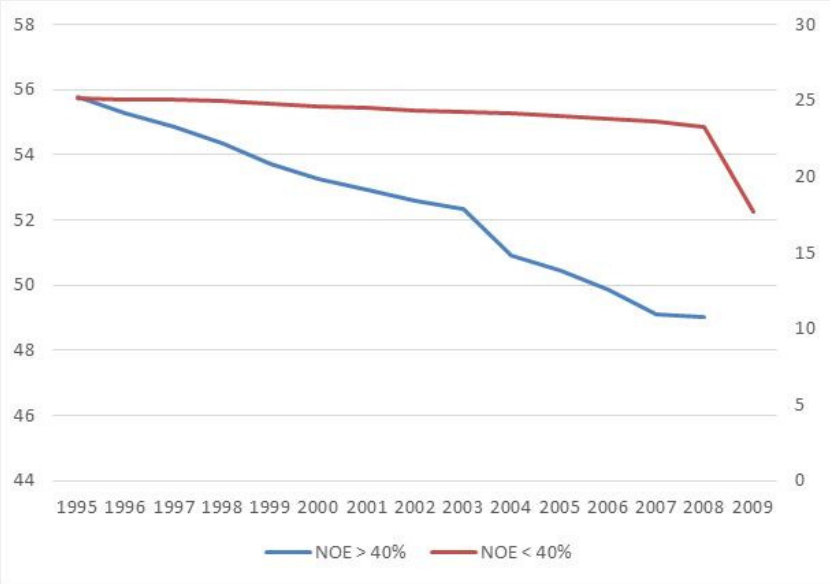
Null Hypothesis:	Obs	F-Statistic	Prob.
GINI does not Granger Cause NOE_BELOW40	286	11.4720	0.0008
NOE_BELOW40 does not Granger Cause GINI		3.93862	0.0482

The results are consistent with the previous test regarding the hypothesis of income inequalities causing *NOE*. Although, we also find, for a statistical significance of 5%, that *NOE* causes income inequalities for countries with values of *NOE* below 40%. Although this hypothesis is less significant than the first (*GINI* "granger-causing" *NOE*), these results raise the following question: are lower sizes of non-observed economy more prone to be associated with economic distortions that increase income inequalities? Based on the literature review presented in Chapter 2, the main

mechanisms that seem to operate in this direction are related with corruption and productivity. Since these countries already present a low dimension of the non-observed sector, increasing informal and underground activities seems to impact income distribution inequalities. In fact, it is easier to disturb an economy that has few non-observed activities by increasing them, than disturbing an economy that works around a preeminent non-observed sector. In our literature we identified, first, productivity of informal firms as one of the main mechanisms operating from *NOE* to income inequalities (Mishra and Ray, 2010). Inherent to this element is the ability of firms to capture productivity premiums. Informal firms, which by not complying with regulations cannot benefit from public institution services, fail to seize premiums that derive from formality. These premiums may appear as efficiency gains, for example. Hence, more *NOE*, in this context, fosters income inequalities since firms are not as efficient as they would be, lowering their potential returns thus boosting inequalities. In countries with lower *NOE*, the fact that some firms act informally may create greater distortions than in an environment where there are already a large number of firms acting informally, hence already greater income inequalities. Second, corruption also acts as a vehicle from *NOE* to income inequalities (Mishra and Ray, 2010). In the same vein, corruption may cause greatest distortions towards income inequalities in countries where it has little expression – assuming corruption as a form of *NOE* – than in countries that already present higher corruption levels. Third, informal labour (Lukiyanova, 2015; Elia and Di Porto, 2011; Estevão and Filho, 2012) is also one of the recurrent mechanisms referred in this causal direction. Informal labour, are described in the literature as mostly low-skilled and prone to more unequal wage distribution among workers therefore causing income inequalities. In countries where there is a more equally distributed income, these factors reflected as *NOE* may in fact have greatest impacts in their income distribution than in economies where income inequality is already high.

The following picture illustrates that, *NOE* has been decreasing overall, but the decrease has been stronger in countries with larger *NOE* estimations. Within our sample we find 29 countries with *NOE* below 40% and 11 above 40%.

Figure 7. *NOE* average estimates for countries with a *NOE* above and below 40% of GDP



GRANGER CAUSALITY – DEVELOPING COUNTRIES subsample

Considering now the low-income countries subsample, we have gathered the results in Table 11 regarding the causality tests.

Table 11. Granger Causality test results – *NOE* estimates for low-income countries and *GINI*

Sample: 1995 2009
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GINI does not Granger Cause NOE_LOWER	141	16.7301	7.E-05
NOE_LOWER does not Granger Cause GINI		0.01782	0.8940

For this group of countries, it is clear that income inequalities cause the size of non-observed economy. The countries listed in this group, lower income countries, are

mostly emerging countries or transition economies from our sample: Armenia, Belarus, Bolivia, Bulgaria, Colombia, Dominican Republic, Ecuador, El Salvador, Georgia, Honduras, Paraguay, Peru, Romania and Ukraine. On the subject of *NOE* and income inequalities, emerging and transition economies are the most studied group of countries, which allows us to identify the mechanisms relating the two variables. Most of these operate from income inequalities to non-observed economy, hence this result is in line with the expectations we have built based on the literature review. The most important mechanisms that we have identified in this direction were: taxes, quality of institutions and composition of the aggregate demand. For example, Dessy and Pallage (2007) stated that, for any increase in the tax rate, lower income classes have an incentive to go underground, informal or illegal. Hence, this effect tends to be more pronounced in poorer countries, reinforcing the evidence that, the more unequal economies are, the greater is the stimulus to increase the non-observed sector. Additionally, in poorer countries, governments are less able to enact policies as to improve the redistribution of income either through effective tax collection or by setting quality institutions capable of supervising efficiently economic activities; they are also unable to provide public services such as education and health facilities on a large scale basis. These distortions contribute, directly and indirectly, to increase income inequalities, and poorer individuals tend to seek alternative sources of income through informal and underground activities such as crime, self-consumption or working for informal firms, *i.e.*, informal labour.

Following the above procedure, we also test the causality using now the subsample of countries with *NOE* values above or equal 40%, the results are the following:

Table 12. Granger Causality test results – NOE estimates above 40% and *GINI*

Sample: 1995 2009
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GINI does not Granger Cause NOE_ABOVE40	108	14.2269	0.0003
NOE_ABOVE40 does not Granger Cause GINI		1.80289	0.1823

Indeed, these results show that income inequalities cause *NOE*, which is consistent with our previous arguments and results controlling for low income countries. Regarding the conclusion we draw when testing for countries with *NOE* values below 40% - *NOE* may cause income inequalities - these results show that this does not hold in the case of developing countries. [4]

Apparently, evidence that *GINI* causes *NOE* is rather robust across countries; the reverse causation does not clearly apply in the case of developing countries, but there is evidence of *NOE* causing *GINI* when *NOE* estimates are low (below 40% of GDP).

GRANGER CAUSALITY – Detailed analysis: TAX EVASION

When testing for the causality nexus using tax evasion as a reference for *NOE*, we perform the tests for all the available data. The database is now different and, as referred before, the group of countries included covers only high-income ones. Non-observed economy can take the form, for example, of non-legal transactions, crime, informal or underground productivity and tax evasion. Hence, to understand the complexity of the relationship between *NOE* and income inequality we first, perform

[4] When testing for the *NOE* threshold of 20% (considering values above or equal to 20% and below20%) we found that *GINI* causing *NOE* is the only statistically relevant hypothesis. This suggest that only a few number of countries that account for *NOE* estimates above 20% but below 40% are susceptible of presenting statistical relevance for the hypothesis of *NOE* causing *GINI*. The countries considered in the sample to have estimates below 20% are: Austria, Denmark, Finland, France, Germany, Ireland, Kyrgyz Republic, Luxembourg, Netherlands, Sweden and United Kingdom. Countries that present estimates between 20% and 40% are the following: Argentina, Belgium, Brazil, Bulgaria, Colombia, Costa Rica, Dominican Republic, Ecuador, Estonia, Greece, Italy, Lithuania, Paraguay, Poland, Portugal, Romania, Russia and Spain.

the test for the causality between tax evasion and Gini Coefficient to understand if the causality nexus varies depending on the type of non-observed activities.

Table 13. Granger Causality test results – tax evasion and *GINI*

Sample: 1999 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
TAX_EVASION does not Granger Cause GINI	169	5.07560	0.0256
GINI does not Granger Cause TAX_EVASION		0.00899	0.9246

The results on Table 13 suggest that tax evasion can explain the causality from *NOE* to income inequality found in the previous results for developed countries. However, the literature and most of the research, when referring to taxes, mentioned its ability to operate from income inequality to non-observed economy (*e.g.*, Dessy and Pallage, 2003). Despite this fact, these results allow discussion about the direction of the causal nexus varying depending on the different types of activities enclosed in *NOE*. In this case, tax evasion causes income inequalities at 5% statistical significance. We can, nonetheless, put forward some mechanisms that may explain this causality nexus. First, higher tax evasion reduces significantly public budget revenues. Thus less tax revenue constrains the redistribution of wealth and income by the government. The literature often suggested the ambiguous effect of taxes on income inequalities (Dessy and Pallage, 2003). On the one hand, higher taxes may lead individuals to perform non-observed activities as a way to increase their income and evade taxation. Hence, by avoiding taxation, governments loose important revenues which could be targeted to the redistribution of income among citizens. On the other hand, higher taxes may contribute through the same way to a more equal distribution of income. Underlying these mechanisms, there seems to be an important vehicle transmitting the effects. We argue, based on the literature (*e.g.*, Chong and Gradstein, 2007; Rosser Jr. *et al.*, 2003), that this intermediate vehicle corresponds to the quality of institutions. Most of the countries of the sample are developed economies. This leads to the second consideration: looking at our sample of 19 countries, all a part of OECD and most of them being high-income countries, the possibility of *NOE*, in this context represented as tax evasion, causing

income inequalities, is a result in line with the precedent findings in this section (see section developed countries, above). Higher income countries are more prone to verify the hypothesis of *NOE* causing income inequality. In this case, tax evasion is an important "vehicle" of transmission of this causal relation. We conjecture that a good set of institutions, working towards effectively controlling inequality, may be severely affected by tax evasion on their financing. In this group of countries, institutions and governments play an important role and perform better their functions. Hence, for these countries, tax evasion may be devastating to the functioning of the economy creating such distortions that it enhances income inequalities Due to lack of data for lower income countries, we are unable to verify the veracity of this premise and compare the different results. Ambiguous causality relation between taxes (or tax evasion) can, indeed, be related to the state of development of countries. For instance, Chong and Gradstein (2007) argue that developed countries present lower sizes of *NOE* and tend to have more institutional quality and less unequal income distribution. Additionally, our results for values of *NOE* below the threshold of 40% of GDP also indicate that the hypothesis of (general) *NOE* "granger-cause" income inequalities is statistically significant. Thus, in countries where non-observed activities are less relevant, its existence or growth may have more impacts on income inequality than in countries where *NOE* is far more important (above the threshold of 40%). Assuming a negative impact of *NOE* on *GINI*, both results lead us to believe that increasing *NOE* is more harmful to inequality in developed rather than in developing countries.

Moreover, the causality relation running from *GINI* to *NOE* found before (developed countries) does not, apparently, hold for the case of tax evasion alone. Apparently, the reverse causal direction (from income inequalities to general *NOE*) may be explained by other types of activities in the *NOE*. Another potential explanation may be related to the fact that most of the countries presented in the current sample are developed economies, hence presenting more equally distributed income and greater quality of institutions that may help preventing tax evasion.

In the following tests, the selected *NOE* measure adds self-employment to the tax evasion estimates. The results are as follows:

Table 14. Granger Causality test results – tax evasion accounting for self-employment and *GINI*

Sample: 1999 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
TAX_EVASION_SELF does not Granger Cause GINI	169	7.14237	0.0083
GINI does not Granger Cause TAX_EVASION_SELF		9.7E-05	0.9921

The result of *NOE* causing *GINI* using tax evasion that also accounts for self-employment as a proxy for *NOE* is statistically more significant than that obtained considering only tax evasion as a proxy for *NOE*. We may understand these results through the lens of our literature review concerning informal labour. Elia and Di Porto (2011), for example, in a study for Italy covering 2000 to 2005, state that informal labour includes mostly low-skilled whose earnings are significantly lower than that of formal workers. Since self-employment may be extensively related to self-consumption activities, it is fair to assume that they are also, to a considerable extent, low-skilled with lower earnings. In fact, lower (declared) earnings associated with self-employment may reflect more income inequalities. Moreover, Lukiyanova (2015) also enhances the difference of hourly wages in formal and informal labour. Wages of informal workers are more prone to polarization, hence are more unequally distributed.

GRANGER CAUSALITY – Detailed analysis: SELF-EMPLOYMENT

Isolating self-employment from the estimates of Buehn and Schneider (2012b) the results still hold to the hypothesis of forms of *NOE* causing inequalities and not verifying the reverse causal relation.

Table 15. Granger Causality test results – self-employment and *GINI*

Sample: 1999 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
SELF_EMPL does not Granger Cause GINI	169	4.81731	0.0296
GINI does not Granger Cause SELF_EMPL		0.04791	0.8270

4.3. Details on the nature of the causal relationship between *NOE* and *GINI* – A 2SLS approach

In order to better investigate the causal relationship between *NOE* and *GINI*, we implement a Two-Stage Least Squares (2SLS) approach. This method complements our previous findings since the causality test determined that inequalities do indeed impact on *NOE*, and also that *NOE* may influence the levels of income inequality in higher income countries. Hence, these results imply a simultaneous-equation since there is a two simultaneous causal relationship to consider. The method of the 2SLS is one of the approaches used in simultaneous-equation problems.

At the present stage, we do not know the neither the magnitude nor the direction of the impacts between these two variables. So, in order to define the 2SLS model, we just rely on the available literature. The 2SLS method will allow us to quantify the effects in two stages, which involves two successive OLS regressions (Gujarati, 2009). The first stage of this method corresponds to estimate *GINI* or *NOE* through instrumental variables, where *GINI* or *NOE* are the dependent variables, but also appearing, interchangeably, as explanatory variables (see equations 4.3 and 4.4). Suppose, for the sake of illustration, that we are testing the influence of *GINI* on *NOE* (equation 4.3) and we know that both are mutually dependent or endogenous variables and thus *NOE* is surely correlated with the stochastic disturbance terms. As this two-stage procedure indicates, the basic idea behind 2SLS is to "purify" the stochastic explanatory variable *GINI* by performing the reduced-form regression of *GINI* on all the predetermined variables in the system (Stage 1), obtaining the estimates, $\hat{GINI}$, and replacing the latter in the original equation; then apply OLS to the equation thus

transformed (Stage 2). The estimators thus obtained are consistent; that is, they converge to their true values as the sample size increases indefinitely (Gujarati, 2009).

For this analysis, the equation that identifies *NOE* as a dependent variable (4.3) is an adaptation from the regression used by Chong and Gradstein (2007). This study provided strong evidence of income inequalities being a determinant of the size of NOE, along with labour rigidities and institutional quality. Taking the original equation from Chong and Gradstein (2007), we remove labour rigidities as an explanatory variable since we were unable to find adequate data, and replaced the variable by taxes in terms of GDP. Using this variable is coherent with the literature since taxes were invoked by Schneider and Enste (2000), along with social transfers paid by households, as the main causes for an increasing *NOE*. The variable taxes is defined as the percentage of total taxes on gross domestic product (tax burden), data provided by the World Bank.[5] We kept the other explanatory variables used in Chong and Gradstein (2007): institutional quality, inst, and income inequality, *GINI*. Institutional quality is represented by the rule of law from the Worldwide Governance Indicators, a measure that intents to represent the confidence of individuals in society rules, contract enforcement, property rights public institutions as police and courts.[6] Finally, as previously done, we use the Gini Coefficient to represent income inequality.

The regression used to estimate *GINI* is based on Portela (2013), a recent study on the macroeconomic determinants of income inequality. Selected dependent variables to explain *GINI* are: real GDP *per capita* (GDPpc), real GDP *per capita squared* ($GDPpc^2$), unemployment (Unemp), inflation (Inflation) and credit constraints (Credit) - reflected by domestic credit to private sector by banks % GDP. Data come from the World Bank – World Development Indicators.

(4.3) $$NOE_{1t} = \beta_{10} + \hat{G}ini_{2t} + \gamma_{11} taxes_{1t} + \gamma_{12} Inst_{2t} + \mu_{1t}$$

(4.4) $$Gini_{2t} = \beta_{21}\widehat{NOE}_{1t} + \beta_{22} GDPpc_{2t} + \beta_{23} GDPpc_{2t}^2 + \beta_{24}(Unemp - Unemp_{t-1})_{2t} + \beta_{25} Credit_{2t} + \beta_{26} Inflation_{2t} + \mu_{2t}$$

[5] Data provided at http://databank.worldbank.org/data/home.aspx accessed (21/09/2015).

[6] Data provided at http://info.worldbank.org/governance/wgi/index.aspx#home accessed (21/09/2015).

In order to estimate the two equations above, we build another panel containing data for 22 developed countries[7], from 1998 up to 2009.

From the related literature, we expect the application of the 2SLS method to find (i) a positive causality nexus from *NOE* to *GINI* and from *GINI* to *NOE*; (ii) a positive sign for the impact of taxes on *NOE* and, finally, (iii) a negative sign for the influence of institutional quality on *NOE*, meaning that increasing institutional quality should decrease *NOE*. Regarding income inequality we expect (i) a negative sign for the impact of GDP *per capita* and of GDP *per capita* squared; (ii) a positive impact of unemployment on inequality and (iii) a positive sign for the credit facilities.

In the following table we present the estimation results.

Table 16. Two-Stage Least Squares results – *NOE* as dependent variable

Sample (adjusted): 2000 2009
Periods included: 9
Cross-sections included: 22
Total panel (unbalanced) observations: 154
Instrument specification: C RULE_LAW GDP_PERCAPITA GDP_PERCAPITA2 INFLATION CREDIT UNEMPLOYMENT -UNEMPLOYMENT(-1) TAXES01

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.80196	1.170864	25.45297	0.0000
GINI	0.003513	0.001023	3.435461	0.0008
RULE_LAW	-9.286810	0.538171	-17.25625	0.0000
TAXES01	0.058831	0.041956	1.402197	0.1629

R-squared	0.687094	Mean dependent var	21.01864
Adjusted R-squared	0.680836	S.D. dependent var	7.144327
S.E. of regression	4.036161	Sum squared resid	2443.590
F-statistic	208.5054	Durbin-Watson stat	0.069742
Prob(F-statistic)	0.000000	Second-Stage SSR	1510.478
Instrument rank	8		

As table 16 reports, we found evidence for the positive causal nexus between

[7] Countries of 2SLS panel data: Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden and United Kingdom.

NOE and *GINI*, since the *GINI's* coefficient is positive: although the associated estimate is close to 0, it is nonetheless statistically significant at 5%. This result corroborates our expectations and is explained by one of the recurring mechanisms identified by our literature review: the more unequal are income distributions among countries (at least concerning declared incomes used in the estimation of the Gini Coefficient), the more stimulus there are for poorer individuals to become a part of the non-observed economy. We note, however, that this sample is composed mostly by developed economies that, according to our previous findings (see section 4.2), present mixed results in what regards the causality *GINI-NOE*. Indeed, results showed that *GINI* causes *NOE,* and *NOE* causes *GINI* (for the sample of countries with *NOE* below the threshold of 40%).

Concerning taxes, we found that, although with the expected sign, the variable is not statistically significant. This is not the result that we expected, since in earlier literature (see Schneider, 2005) taxes have been identified as one of the main contributors to increasing non-observed activity. However, we must also recall the study by Dessy and Pallage (2003), which advocates the ambiguous effect of taxes on the non-observed economy (further explained in chapter 3 above). Moreover, taxes may, in fact, reduce non-observed sector if the revenues are allocated to public institutions and in turn being able to enhance welfare and to provide infrastructures that enhance formality premiums captured by firms once they act on the formal economy (see Mishra and Ray, 2010; Dessy and Pallage, 2003). Additionally, a larger tax burden may also be correlated with lager transfers and public services that, by increasing money income or access to several services, reduce the incentives of the low-income households to deviate towards *NOE*. These effects may balance those related to the willingness for tax evasion the higher tax burden is.

The hypothesis of institutional quality as an important determinant of *NOE* is corroborated by our results and in line with our expectations: its estimate coefficient is negative and statistically significant. This leads to the conclusion, as the related literature has been mentioning (e.g., Chong and Gradstein, 2007; Dessy and Pallage, 2003), that the quality of institutions plays an important role in preventing increases of the non-observed economy.

Concerning the estimated results when *GINI* is the dependent variable (see Table 17, below), *NOE* negatively affects *GINI* with a negative coefficient of 67.6,

statistically significant at 0.56%. This allows us to conclude that, when observing the reverse causal relationship (*NOE* causing income inequalities), the direction of the causality is negative, meaning that increasing non-observed economy reduces inequalities. This result may be explained by the nature of the variables: the Gini coefficient is based on declared incomes; hence, it does not include incomes that come from informal or underground activities. Our hypothesis on this is the following: on the one hand, a stronger law enforcement means fewer incentives to become part of the non-observed sector, resulting on more declared income, which can mean more unequal distribution patterns since, more often, it is the lower-class individuals that seek for other sources of revenues in the non-observed sector; on the other hand, the lower is law enforcement, the greater is tax evasion and official income can be "officially" more equally distributed. Following this *rational*, more observed economy can in fact lead to lower income inequalities. Furthermore, our results show evidence that increasing GDP *per capita* and credit constraints decrease income inequality, and that inequality increases as the unemployment rate accelerates. These results are in line with Portela (2013) findings and with most of the related literature therein. In fact, decreasing income inequality along with increasing GDP *per capita* corroborates the Kuznet's hypothesis, as long as countries exhibit a sufficiently high record of GDP *per capita*. Furthermore, larger credit constraints are found to negatively impact on income inequality (*cfr.* Portela, 2013). Moreover, increasing unemployment is likely to increase inequality since it is a variable that captures the most the effects of economic cycles, meaning that in expansionary periods (where unemployment rates usually fall), inequality and unemployment decrease, behaving inversely during recessions. In our estimations, inflation is not statistically significant, probably due to the fact that inflation in the countries of our sample is rather stable and low, hence not being a relevant explanatory variable for explaining *GINI*.

Table 17. Two-Stage Least Squares results – *GINI* as dependent variable

Sample (adjusted): 2000 2009
Periods included: 9
Cross-sections included: 22
Total panel (unbalanced) observations: 154
Instrument specification: C RULE_LAW GDP_PERCAPITA GDP_PERCAPITA2 UNEMPLOYMENT-UNEMPLOYMENT(-1) CREDIT TAXES01 INFLATION

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2953.738	793.9920	3.720111	0.0003
NOE	-67.61678	24.02811	-2.814070	0.0056
GDP_PERCAPITA	-0.036792	0.013945	-2.638469	0.0092
GDP_PERCAPITA2	1.77E-07	1.06E-07	1.670502	0.0969
UNEMPLOYMENT-UNEMPLOYMENT(-1)	90.99030	43.28027	2.102351	0.0372
CREDIT	-4.940656	1.679356	-2.941994	0.0038
INFLATION	21.47777	22.63720	0.948782	0.3443

R-squared	0.158090	Mean dependent var	269.6220
Adjusted R-squared	0.123726	S.D. dependent var	737.0358
S.E. of regression	689.9355	Sum squared resid	69973607
F-statistic	6.159760	Durbin-Watson stat	0.157667
Prob(F-statistic)	0.000009	Second-Stage SSR	66414955
Instrument rank	8		

5. Conclusions

The literature has already built some clues on the possible relationship between *NOE* and income inequality, mostly enhancing that larger *NOE* estimates usually go along with higher income inequality. However, there is not a clear overview of the mechanisms relating both variables as well as on the nature and the sign of their causal relation. The aim of our work is to give an overall review on this subject and to answer the following questions: (i) what are the main mechanisms relating inequality and the size of non-observed economy?; (ii) what is the dominant causality relation – from inequality to non-observed economy or the other way around?; and finally (iii) what is the direction of the relationship: are the variables moving along in co-movement or are they inversely related?

Using Granger Causality tests, we contribute to the findings already present in the related literature, through categorizing results by country types. Using a panel data covering 40 countries from 1995 until 2009, we were able to assess that: (i) for the full sample there is a statistically significant bi-directional causal nexus between *NOE* and income inequality. However, causality running from income inequality to *NOE* was much more significant than the corresponding reverse causality; (ii) for the subsamples of developed and developing countries, we also found evidence for income inequality causing *NOE* and, when testing for countries presenting *NOE* estimates below the threshold of 40%, we also found that *NOE* causes income inequality. Since this evidence was not observed when testing for the subsample containing data for developing economies and countries with *NOE* estimates above 40%, an important question emerges, which we leave here for future investigation: is a lower dimension of *NOE* more prone to be associated with economic distortions able to increase income inequalities?

Additionally, using a different panel consisting of 19 OECD countries with data covering the years of 1999 until 2010, we also tested for the causal nexus between income inequality and two forms of *NOE*: tax evasion and self-employment. The results were unequivocal: these forms of *NOE* are causing income inequality, and not the other way around. We conjecture that the remaining forms of *NOE*, such as informal labour and production, crime and other underground activities, are the ones caused by income

inequality. In summary, we found more robust evidence that causality runs from income inequality to *NOE*.

Finally, to fully encompass the relationship between *NOE* and income inequality, we implemented a 2SLS method, using a different panel (22 developed countries and covering annual data from 1998 to 2009), to better explain the relationship between these two variables. Our results suggest that, when income inequalities are causing the non-observed economy, both variables move in the same direction (positive coefficient). However, the reverse causal relation (*NOE* causing inequalities) suggested that the non-observed economy and income inequalities move inversely (negative coefficient). Moreover, our findings corroborate the hypothesis that taxes have an ambiguous effect on *NOE* since they are not statistically significant; institutional quality appears as an important explanatory variable of *NOE*, exhibiting a negative and statistically significant impact. Concerning the exogenous determinants of income inequality, we conclude that GDP *per capita* and credit facilities promote a more equally distributed income.

This work, however, entails some fragilities. In fact, the data gathered to apply Granger Causality tests using different types of *NOE* (tax evasion and self-employment) was not fully encompassing since we only considered developed OECD countries and thus did not allowed us to categorize the results by country of different development groups. Moreover, several forms of *NOE* were left out of this analysis. This was a limitation that we also found when building the panel for the 2SLS approach which considered only developed countries.

Another limitation that requires caution in interpreting our results is that the inequality measure is rather narrow. In fact, the *GINI* coefficient refers to inequality in reported disposable income. Thus we are unable to assess if *NOE* effectively reduces income (both reported and unreported) inequality. Moreover, other measures of inequality, such as consumption (encompassing private and public utility services) inequality, would be more adequate and results may surely change.

Bearing these drawbacks in mind, we propose some suggestions to be addressed in further work. First, similar tests should be applied to larger panels – more country and time span inclusive – in order to assess differences between developed and developing countries. We found that *NOE* and income inequality have different causal

nexus according to the level development of the country. Thus the development level may be relevant to control for as it may change either the causality nexus between different types of *NOE* and inequality measures, and the magnitude and sign of the relationship.

Second, and in order to better understand the nature of the relationship between *NOE* and inequality, we suggest to use data on more detailed forms of *NOE* (crime, informal labour, corruption, etc) and of inequality (*e.g.*, consumption inequality).

Finally, and since countries with *NOE* below 40% appear to provide statistical significant evidence supporting the hypothesis of *NOE* causing income inequality, we find the next question relevant for future research: is *NOE* more likely to cause larger distortions that may crucially affect by more income inequality in developed rather than in developing economies?

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Annexes

I. Causality tests results for countries presenting NOE above and below 20%

Sample: 1995 2009

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
NOE_ABOVE20 does not Granger Cause GINI	280	1.59779	0.2073
GINI does not Granger Cause NOE_ABOVE20		29.9511	1.E-07

Sample: 1995 2009

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
NOE_BELOW20 does not Granger Cause GINI	117	1.12464	0.2912
GINI does not Granger Cause NOE_BELOW20		10.8942	0.0013

II. Stationary test for *NOE* and *GINI*

Panel unit root test: Summary
Series: NOE
Sample: 1995 2008
Exogenous variables: None
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-20.5453	0.0000	37	446
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	335.763	0.0000	37	446
PP - Fisher Chi-square	454.683	0.0000	37	481

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: GINI
Sample: 1995 2008
Exogenous variables: None
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.30562	0.0000	37	353
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	78.6496	0.3340	37	353
PP - Fisher Chi-square	111.005	0.0035	37	362

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.